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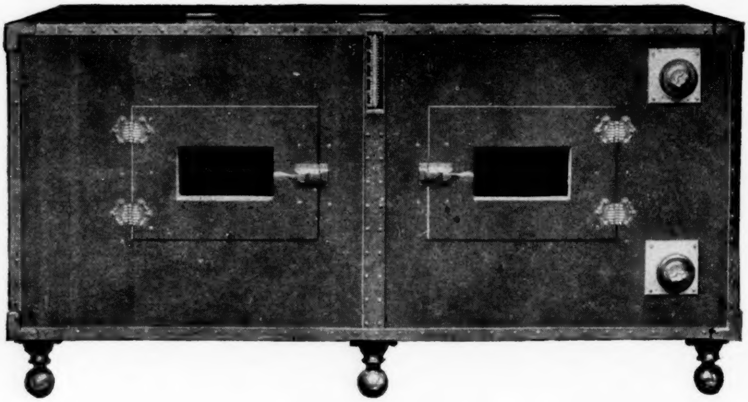

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The Journal of the American Association of Cereal Chemists

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VOL. VII. JULY, 1922 No. 3

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COATES HOUSE
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Laidley, Paul, Provident Chemical Works, St. Louis, Mo.; Lentz, H. L., Robinson Milling Co., Salina, Kans.; Leatherock, L. E., Kansas Milling Co., Wichita, Kan.; Liggett, Harry D. Jr., Colorado Mill & Elev. Co., Denver, Colo.; Lawellin, S. J., Eagle Roller Mill, New Ulm, Minn.; Lyman, G. S., Kansas City Testing Laboratory, Kansas City, Mo.;

McLaren, L. H., Pillsbury Flour Mills, Minneapolis, Minn.; Mann, Paul L., Asst. Prof. Mlg. Ind. K. S. A. C., Manhattan, Kan.; Maher, L., Larabee Flour Mills Corp., Clinton, Mo.; Mitchell, H. E., Blackwell Mlg. & Elev. Co., Blackwell, Okla.; McCoy, A. J., Wyandotte Elev., Inc., Kansas City, Mo.; Mitchell, R. Wallace, Am. Baking Materials Co., Menomonie, Wis.; McVey, R. V., Arkansas City Milling Co., Arkansas City, Kan.; Mann, M. C., Consolidated Flour Mills Hutchinson, Kan.; Morgan, Ralph P., Newton Milling & Elev. Co., Newton, Kan.; Morison, Dr. C. B., American Institute of Baking, Chicago, Ill.;

Olsen, Leslie R., International Milling Co., New Prague, Minn.; Osborn, H. L., Oklahoma City Mill & Elev., Oklahoma City, Okla.;

Patterson, C. J., Campbell System, Kansas City, Mo.; Patterson, P. M., Sawyer Mill Co., Hutchinson, Kan.; Pitts, P. R., Acme Evans Co., Indianapolis, Ind.; Patterson, F. D., Texas Star Flour Mills, Galveston, Texas;

Potts, R. B., Wichita Flour Mills, Wichita, Kan.;

Rainey, W. L., Hutchinson, Kan.; Ross, Hugo, Modern Miller, Kansas City, Mo.; Ross, M. C., Lindsborg Mill & Elev. Co., Lindsborg, Kan.; Rogers, Walter J., Crete Mills, Crete, Nebr.

Schulz, M. E., Weber Flour Mills, Salina, Kan.; Stork, Chas. T., Noury & Van der Lande, Buffalo, N. Y.; Stone, J. D., Maple Leaf Milling Co., Winnipeg, Mass.; Shiple, V., National Milling Co., Toledo, Ohio; Sasse, A. R., Southwestern Milling Co.;

Tucker, Floyd L., Consolidated Flour Mills, Winfield, Kan.; Thompson, H. Lee, Gooch Milling & Elev. Co., Lincoln, Nebr.; Thrailkill, E. W., Snell Mill. & Gr. Co., Clay Center, Kan.; Tibbing, E. F., Washburn-Crosby Co., Minneapolis, Minn.

Vanpel, H. F., El Reno Mill & Elev. Co., El Reno, Okla.

Warren, M. R.; Quaker Ooats Co., Cedar Rapids, Iowa; Warning, Wm. G., Provident Chemical Works, St. Louis, Mo.; Weaver, H. E., Larabee Flour Mills, St. Joseph, Mo.; Webb, Sam Jr., Milling & Grain News, Kansas City, Mo.; Whittaker, A. K., Plant Milling Co., St. Louis, Mo.; Wood, J. C., Scott County Mill Co., Sikeston, Mo.; Ward, Clarence, Goerz Flour Mills Co., Newton, Kan.; Wilkins, S. D., Purina Mills, St. Louis, Mo.;

Yantis, Harvey E., The Northwestern Miller, Kansas City, Mo.

MONDAY MORNING, JUNE 5TH.

10:00 A. M.

1. Registration.
2. Introduction of Members.
3. Opening address by President Lawellin.
   14 States and Canada represented.
4. Reading of Communications.
   "Wheat Tests"—Editorial from Southwestern Miller, May 30, 1922.
   Letter from Newton C. Evans, Editor, National Miller.
   Letter from L. D. Jackson of Winnipeg, Canada.
   Letter from Prof. E. L. Tague of Manhattan.
   Letter from Wm. L. Frank, Sherman, Texas.
   Letter from Fred Loomis, Saskatoon, Sask., Canada.

Motion by Mr. Herman and seconded that we have picture of association taken. Carried.

Hess, Schulz and Morgan appointed to get two columns of news for National Miller Convention Daily; Leslie, Olsen, L. E. Leatherock appointed on Chemists-Millers "get acquainted" committee.

Banquet.—Annual A. A. C. C. Banquet; vote of 30 to 4 for stag banquet for members and visitors, Thursday night. A. R. Sasse and R. J. Clark on Banquet Committee. Theater party for ladies night of our banquet.

Motion by Harper that we have a rousing meeting of chemists and millers in banquet Thursday night. No second.

Motion by Lentz that we have Stag Banquet Thursday night for members, visitors and invited millers. Seconded, carried.

MONDAY AFTERNOON, JUNE 5TH.

1:30 P. M.

Paper—"The Pedagogy of Cereal Chemistry" by A. B. Hess of The Wolf Chemical Company, Chambersburg, Pennsylvania.

Paper—"Why the Cereal Chemist?" by our booster friend, Forrest Anderson ,of the Wilkens-Anderson Supply Company, Chicago, Illinois.

Paper—"Cereal Chemistry the Stepping Stone" by H. T. Hemperly, of the Hemperly Flour Company, Kansas City, Missouri.

Paper—"Some Observations on the Seasonal and Sectional Variations in Kansas Wheat", by Roy V. McVey, Arkansas City Milling Company, Arkansas City, Kansas.

Discussion on Yellow Berry and Kanred Wheat. Leatherock, Herman, Thompson, Lawellin gave their experience with above. Also H. N. Clark, Alexander, F. D. Patterson, Hess, McVey, Blish, and Heon.

Ratio of Nitrogen to Potash affects Protein Content. That is, climatic and soil conditions at time of heading of grain affect nitric nitrification which is productive of yellow berry or dark hardness.

Paper—"Texture vs. Protein Content vs. Kernel Weight", by Wm. L. Frank, Sherman Grain & Cotton Exchange, Sherman, Texas.

Discussion.

Recess for ten minutes.

Executive session for ten minutes.

Mr. Buck moved, and was seconded, that we accept the nominations of Executive Committee for officers to be voted on at regular business meeting. Carried.

Suggested that we have Business Session Wednesday morning at 8:00 A. M., in order to give time to visit mills.

TUESDAY MORNING, JUNE 6TH.

9:00 A. M.

Announcements.

Paper—"Crude Fiber Determinations", by S. J. Lawellin.

Discussion.

Letters read from Art Kelley, Prof. Harcourt.
Telegram read from E. B. Clark.
Prof. Fitz unable to be present.

Nominations of Executive Committee.

For President	Lawellin, Olsen, Weaver
For Vice-President	Herman, Alexander, Durham
For Secretary-Treasurer	Jones, Potts, Buck
For Editor	Hess, Buck, C. J. Patterson, Mitchell
For Chairman Exicutive Committee	Morgan, R. J. Clark, Rainey

Paper—"Water Softening in Mill Power Plants", by M. E. Schulz, Weber Flour Mills, Salina, Kansas.

Discussion.

Dr. C. B. Morison, American Institute of Baking, Chicago, Illinois, gave description of the organization and purposes of the Institute. Also arrangement and equipment.

Discussion.

Dr. Bailey suggests that the A. A. C. C., the Bakers, the Millers, Official Agricultural Chemists and the Society of Milling & Baking Technology get together on methods of analysis, urging co-operation.

Talk by Mr. M. H. Parlin on Uniformity of Methods.

Hess and Jones told about Chemists' Round Table of Kansas Millers League.

C. J. Patterson, L. R. Olsen and J. R. Hess appointed as special committee to make recommendation to bring about uniformity in methods of analysis, with other organizations.

Mr. Lawellin urges every chemist to belong to the American Chemical Society.

Dr. Bailey talked about ash, describing type of muffle with preheated air and also oxygen through tubular muffle at about 500-525° C. Cutting time of ash determination to about 1½ hours. Silica tube used in above furnace.

J. R. Hess talked on Ash.

TUESDAY AFTERNOON, JUNE 6TH.
1:15 P. M.

Paper—"Chemist-Miller-Baker, Acquainted", by R. Wallace Mitchell, American Bakery Materials Company, Menominie, Wisconsin.

Paper—"Relations Between Millers and Chemists", by Newton C. Evans, Editor, National Miller, Chicago, Illinois.

Dr. Carl L. Alsberg, director of Stanford Food Research Institute, Stanford University, California, gave us a talk on the organization and necessity which brought into existence the Stanford Food Research Institute of Stanford University, California.

The relations of the food supply to the masses are being studied as a national problem. On account of the great field given them, and on account of their limited funds, they have chosen the wheat industry for their present work on account of its wide application and its simplicity for studying. We are a highly standardized nation. In the cereal industry we need standardized methods and Dr. Alsberg has hopes that our association will co-operate with the A. O. C. C. in this regard.

What is needed is the formulating of methods similar to the American Society of Testing Materials, giving specific directions for each step in analysis. Standards for flour should be adopted, based on service test, that is, what its dietetic value is and not on its present valuation of percentage grade or present grain grades.

Talk by one of our Honorary Members, Mr. Theodore Ismert of The Ismert Hincke Milling Co., Kansas City, Missouri.

Announcements:—11:00 A. M. Thursday morning, Association group picture will be taken.

Paper—"Varieties of Durum Wheat for Semolina Milling" by L. H. McLaren, Pillsbury Flour Mills, Minneapolis, Minn.

Paper—"Some Factors Influencing Protein Determinations", by R. B. Potts, Wichita Flour Mills, Wichita, Kansas.

Discussion.

Paper—"The Use of Perchloric Acid in Protein Determinations on Wheat and Flour", by R. K. Durham, Rodney Milling Company, Kansas City, Missouri.

Message from Allied Association Committee, read by Mr. Hugo Roos.

WEDNESDAY MORNING, JUNE 7TH.
Business Session, Members Only

Meeting called to order by Pres. Lawellin, 8:00 A. M.

Reports of Officers and Committees

Minutes of last meeting read by Secretary. Approved.
Report of President.
Report of Secretary-Treasurer. Approved.
Report of Executive Committee, by Schulz.
Report of Editor.
Report of Auditing Committee, by M. C. Mann.

Election of Officers

Schulz and Harper appointed tellers.

For President—Lawellin 26, Olsen 5, Weaver 4. Lawellin re-elected. Speech.

For Vice-President and Business Manager—Herman 19, Alexander 5, Durham 11. Herman re-elected.

For Secretary-Treasurer—Jones 29, Buck 3, Potts 3. Jones re-elected.

For Editor—Hess 30, Buck 0, C. J. Patterson 1, R. W. Mitchell 4. Hess re-elected.

For Chairman of Exicutive Committee—R. P. Morgan 12, R. J. Clark 10, W. L. Rainey 12. Tie.

Second Ballot: Morgan 14, Clark 8, Rainey 16. W. L. Rainey elected.

Motion by Wood that President appoint two members each year to the Inter-Allied Associations Committee, which committee shall be permanent. Seconded. Carried unanimously.

Recommendations of Co-Operative Method Committee, composed of Leslie Olsen and C. J. Patterson.

June 7, 1922

President,
American Association of Cereal Chemists:

Your special committee appointed for the purpose of bringing about a closer co-operation among the American Association of Cereal Chemists, Association of Official Agricultural Chemists, and the American Institute of Baking, on matters and policies of mutual interest, desire to call the attention of these organizations to the following:

1. The study and investigation of uniform and comprehensive methods for the examination of cereal products. This is of special importance in view of the fact that each organization has already adopted definite methods which present variations in procedure leading to results which are not always comparable.

2. It would seem desirable that in cases of dispute where the results of analysis were involved that the American Institute of Baking could properly serve as a referee.

3. We suggest that each organization have a permanent committee to work out ways and means by which this co-operation can best be effected.

Respectfully submitted,
Leslie R. Olsen, Chairman.
C. J. Patterson.

Mr. Chas. Roos, President of Millers National Federation talked on Inter-Allied Associations Committee.

Discussion regarding the above committee—whether the same committee function with operative millers and Millers National Federation and the co-operative methods committee with the Association of Official Agricultural Chemists and the American Baking Institute.

Hess suggests that referee in cases of dispute be made up of members of American Institute of Baking, Official Agricultural Chemists and American Association of Cereal Chemists.

Co-Operative Methods Committee.—Motion by Hess that President appoint three members to the Co-Operative Methods Committee, who shall hold office for one, two, and three years respectively, and who shall work with the A. O. A. C. and the A. I. B. Seconded. Motion carried unanimously.

Motion by M. R. Warren that these two committees, the Allied Asso-

ciations Committee and the Co-Operative Methods Committee be separate committees and do not function together. Seconded. Motion carried. Motion by Morgan that this matter be reconsidered. Seconded. Carried.

Motion by Morgan that the Allied Associations Committee and the Co-Operative Methods Committee be combined in their membership, which shall consist of three mmbers and function for both committees. Seconded.

Amendment by Lentz. Lost for a second.

Amendment by Warren that we leave it to the discretion of the President to appoint these members. Seconded.

Morgan and Warren withdraw their motions. Accepted.

Motion by Lentz that original motion stand as passed regarding two committees.

Motion by Wood that President appoint each year three members as an Auditing Committee to audit the books of the Secretary-Treasurer. Seconded. Carried.

Recommendations of Allied Associations Committee.

At a meeting of the Allied Associations Committee of the Millers National Federation, American Association of Cereal Chemists and the Association of Operative Millers, held at Kansas City, Mo., June 6th, it was unanimously agreed to make the following recommendations:

That the methods used for determining the moisture content of flour be standardized so as to include all of the so-called "free moisture" and to exclude any possible moisture resulting from the disintegration of organic matter due to excessive temperatures or to prolonged periods of heating during the drying process or possible mechanical losses during aspiration.

That declarations of weight of flour be based on not to exceed 13.5% moisture content and determined by the methods in use or approved by the Division of Chemistry U. S. D. A. at the time this 13.5% moisture standard was promulgated by the U. S. D. A. It is also recommended that a tolerance of 0.3% be allowed for uncontrollable deviations which are known to occur in the moisture analysis of flour. Inasmuch as a great many members of each of the Associations represented by this Allied Committee have complained vigorously because of the wide variations in the analysis of wheat, flour and feeds as determined by commercial laboratories, this committee feels justified in urging each association to do what it can to overcome these lamentable conditions by insisting that reliable chemists perform the analysis, that time be allowed in careful and painstaking work. Further, that the various associations show a willingness to meet increased cost of analysis, if necessary, to assure accurate work.

It is also recommended that the American Bakers Association be invited to appoint two members of their association to act as members of the Allied Committee.

* * *

Motion by Warren that we accept the report of the Allied Associations submitted above. Seconded; carried.

Moved by Morgan that the department of Milling Chemistry in the National Miller be continued, and that the association give its hearty support to the same. Seconded; carried unanimously.

Schulz suggests that the Editor be paid $25.00 to $50.00 per issue for compensation for his work.

Motion by Wood that the Editor be paid $50.00 per issue as a salary. Seconded. Carried.

Suggestion by P. M. Patterson that President appoint an editorial staff to assist him. Motion above carried unanimously.

Motion by Lentz that we make subscription price $2.00 per year for the Journal to non-members with the exception of exchanges, mills and experiment stations. Motion carried.

WEDNESDAY AFTERNOON, JUNE 7TH.

1:15 P. M.

Paper—"Bleaching Processes", by A. R. Sasse, Southwestern Milling Company, Kansas City, Kansas.

Paper—"The Novadel Process of Bleaching", by Chas. T. Stork, American representative of V. H. Loury and Ven der Lande.

Paper—"Bleaching and Maturing of Flour", by Dr. Frederick L. Dunlap, Consulting Chemist of Industrial Appliance Co., Chicago, Illinois.

Paper—"Flour Bleaching Reagents", by Dr. J. C. Baker, Chief Chemist of Wallace and Tiernan Co., Newark, N. J.

Talk by Mr. Marmon of the Alsop Process. Discussion.

THURSDAY MORNING, JUNE 8TH.

Letter read from Walter Stern of Bernhard Stern & Sons, Milwaukee.

Paper—"Of How Much Value is the Protein Test?" by L. R. Olsen, International Milling Co., New Prague, Minn.

Discussion.

Paper—"Flour Strength", by H. E. Weaver and W. A. Goldtrap, Larabee Flour Mills Corporation, St. Joseph, Mo.

Discussion.

Paper—"Molds", by Prof. E. L. Treece, University of Kansas, Lawrence, Kansas.

Discussion.

Dr. Morison reported on some work done at the American Institute of Baking, using a thermocouple in the center of a loaf of bread, showing the temperature of the dough in the pan in the oven, to be 94-96°C. This temperature is high enough to kill mold bacteria but rope bacteria strains are not killed at 100°C. Infection of bread by molds is external and not internal. All mold spores are killed during baking, but contamination after baking, by air or materials, is responsible for mold infection.

Dr. Alsberg suggested through Dr. Morison that the reason why we had so little trouble with rope during the war was on account of the large amount of corn flour used in bread making, which had a high acidity content, while in Europe they did have a good deal of rope. Sterilization by Ultra Violet rays can be used in preventing molds in flour.

Paper—"Insects of the Mill and their Control", by J. C. Wood, Scott County Milling Company. Sikeston, Mo.

THURSDAY AFTERNOON, JUNE 8TH.

Letter read from Prof. Tague saying that on account of ill health he will be unable to be present.

Letter read from Dr. Nelson, saying he would be unable to be present.

Paper—"Bakeshop Practices", by E. B. Clark, Caskey Baking Co., Hagerstown, Mr. Mr. Clerk unable to be present. Paper read by President Lawellin.

Paper—"Changes in Hydrogen Ion Concentration and Effect of Various Treatments on the Hydrogen Ion Concentration of Doughs", by Dr.

C. H. Bailey, University of Minnesota, St. Paul, Minn.

Suggested by Dr. C. H. Bailey that a short course for cereal chemists, under his direction at University of Minnesota, to take up studies of physical chemical methods be offered for advanced study. This course to last about one week. About ten members indicated that they would be anxious to attend.

Talk by Dr. Blish of the Nebraska State Agricultural Experiment Station. Dr. Blish states the necessity of close co-operation between experiment stations and the cereal chemists.

Talk by Dr. L. H. Bailey of the United States Department of Agriculture Bureau of Chemistry, urging that we must make clear, when we adopt official methods of analysis, which methods we are using. Dr. C. H. Bailey says on account of the priority and standing of the Official Agricultural Chemists, that sooner or later results will be embarrassing to one organization or the other, and that as referee of the A. O. A. C. he will do his best to co-operate with our organization in improving the A. O. A. C. methods where necessary.

Executive Business Session.

Consideration of methods submitted by Methods Committee composed of Jones, Hess, Rainey, Mann, Potts and Leatherock, appointed last year.

Discussion as to changing title of our methods.

Motion by Weaver that we change title of our methods to "The Methods of Analysis of the A. A. C. C." noting that the methods we have adopted as official be called the "approved methods" and those not adopted as approved be called "tentative methods." Seconded and carried.

Motion by Lentz that we adopt as a tentative method, the vacuum oven for determining moisture.

Moved by Warren that we adopt the method for moisture as reported, as an approved method. Seconded; carried.

Moved by Mr. Sasse that method for ash be approved. Seconded; carried.

Moved by Harper that we adopt the two methods for protein in flour as reported. Carried.

The methods committee shall investigate the use of HCl for use as standard acid in protein determinations.

Moved by Mr. Heon that we adopt as approved method, the method for protein in wheat meal. Seconded and carried.

Methods Committee: Schulz, Jones, Hess, Leatherock, and Rainey, appointed.

Protein on Feed—Moved by Warren that we adopt this method as approved. Seconded; carried.

Crude Fiber Method—Motion to accept same as reported. Seconded; carried.

Acidity—Moved and seconded that method for acidity be adopted as approved method.

Lentz moved and seconded that we adopt as approved method the method for loaf volume, except that moved by Rainey that the loaf volume be reported in cubic inches instead of cubic centimeters. Seconded; carried.

Motion by Mr. Hess that we make tentative method: that when reporting between laboratories we report specific volume, which shall mean the volume of the loaf in cubic centimeters, divided by the weight of flour used.

Warren moved that method for color scale be left a tentative method for another year. Motion lost for want of a second.

Motion by Buck that we do not adopt a color scale in our methods. Carried.

Moved by Hess that the Bread Formula remain as a tentative method for another year. Carried.

Moved by Lentz that we adopt as a Tentative Method the method reported. Carried.

Jones moved that we reconsider the method of size of loaf pans. Seconded; carried.

Motion by Warren that we do not adopt a tentative size of pans for bread. Seconded; carried.

Motion by Rainey that we adopt as tentative method for water soluble salts as given. Carried.

Moved by Heon that method for water soluble Inorganic Salts be adopted as tentative method.

Method for water soluble proteins be adopted as tentative method by Warren. Carried.

Water insoluble ash adopted as Tentative Method.

Moved by Rainey that we adopt as Tentative Method the one on Reducing Sugars. Carried.

Moved and seconded that method for Alcohol Soluble Proteins be adopted as a Tentative Method. Carried.

Moved and seconded that method for Protein Soluble in 5% $K_2 SO_4$ solution be adopted as Tentative Method. Carried.

Moved and seconded that Glutenin Method be adopted as Tentative Method. Carried.

Moved and seconded that we adopt method for protein in amino compounds as Tentative Method. Carried.

Lentz moved that we adopt method for fat as Tentative Method with correction regarding not over 2% alcohol. Carried.

Motion by Rainey to accept the method for moisture in whole grain as an Approved Method. Carried.

Same for carbohydrates.

Same for nitrogen free extract.

Motion that we accept the tables given on page four (4).

FRIDAY MORNING, JUNE 9TH.

9:00 A. M.

Paper—"Vitamine Review", by W. S. Long, City Chemist, Kansas City, Missouri. Discussio n.

Suggested that the cereal chemist should do a great deal in stopping the fraud being put on the public by firms claiming unusual cures for their so-called high Vitamine products.

Miss Sprague sent word she could not be present.

Dr. Bowen sent word of his illness and could not be present.

Paper—"Notes on Baking", by C. F. Buck, Hoffman Mills, Enterprise, Kansas.

Mr. Olsen, chairman of Committee on Resolutions, reports:

One to Coates House, thanking them for their courteous treatment.

One to Society of Milling and Baking Technology.

One to the Operative Millers Association, expressing our appreciation of their hearty co-operation.

Motion that we accept the above two resolutions; carried.

Motion by Warren that we accept the resolution prepared by the Committee to Dr. C. H. Bailey, as follows:

Dr. C. H. Bailey, President,
American Society of Milling & Baking Technology,
University of Minnesota,
Minneapolis, Minnesota.

The American Association of Cereal Chemists, in convention assembled, having in mind the interests of our profession and believing that much good can be accomplished by a combining of the efforts of the S. M. & B. T. and our efforts, invite for the consideration of the former association the possibility of an amalgamation of the two Societies.

Signed, COMMITTEE.
by L. R. Olsen, Chairman.

Motion by Hess that we consider this matter in business meeting. Seconded; carried.

Paper—"Some Factors Influencing the Determination of Moisture in Flour", by L. E. Leatherock, Kansas Milling Company, Wichita, Kansas.

BUSINESS SESSION

Committee on A. A. C. C. Methods of Analysis appointed by President: Potts, chairman; Hess, Jones, Mann, Schulz, Leatherock.

Audition Committee appointed by President: McCann, P. M. Patterson, J. R. Hess. Mann, chairman.

Executive Committee appointed by President: J. C. Wood, A. A. Heon, M. R. Warren, W. L. Rainey. Rainey, chairman.

Motion by Wood that we amend the constitution so as to omit the word "male" in line two (2), Section One (1), of Membership section of the constitution. Motion seconded; carried.

Resolution to Dr. C. H. Bailey regarding amalgamation of the S. M. & B. T. with our organization, read.

Moved by F. D. Patterson that above resolution be adopted. Seconded; carried.

Moved by A. A. Heon that association have Committee on Sample and Referee work to send samples to all members each month for checking purposes, and the results published in comparison. Seconded; carried.

Fleming, Herman and Sasse appointed, with Herman as chairman.

Inter-Allied Associations Committee appointed by President: H. E. Weaver, chairman, two years; M. E. Schulz, one year.

Annual meeting adjourned, sine die.

By A. A. Jones,
Secretary-Treasurer.

SOME FACTORS INFLUENCING THE DETERMINATION OF MOISTURE IN FLOUR

By L. E. Leatherock

At a meeting of The Kansas Millers' Club Chemists Round Table the wide variation in the moisture content of flour as reported by different laboratories on the same sample was brought to our notice. Therefore, it was decided to send out a check sample to a large number of flour mill laboratories and also those doing commercial work on flour, to try to determine the reasons for the variations.

A 24-lb. sack of freshly milled flour, especially picked for its high moisture content, was taken off the mill and passed rapidly 3 times thru a small hand power laboratory blender to secure uniformity. One hundred small friction top tin cans were quickly filled and sealed with Tirre adhesive tape. 92 of these cans were then mailed out to laboratories with the request that they determine the moisture content, and give us the following information.

1. Moisture content as determined.
2. Weight of sample taken for analysis.
3. Shape and Dimensions of container.
4. Temperature and Time of Drying.
5. Inches Vacuum.
6. Type of Oven (Air, Vacuum, etc.)
7. Name of Oven.

Eight of the original samples were saved for determinations in our own laboratory, our idea being to check the work of the different analists by their own methods after their reports had been received. However, there were such a multitude of methods employed and results obtained that this idea was discarded, and an effort made to explain the wide differences in results by some work on other samples.

Sixty-nine operators of the 92 to which the samples were sent, reported. Results were as follows:

Lab. No.

1 14.24; 5 gms.; Cly Al 2″x⅞, Cover; 5 hrs.; 103; None; Electric Air; Freas
2 14.14; 5 gms.; Cly Al 2″x⅝, Cover; 5 hrs.; 103-104; None; Electric Air; Freas
3 14.54; 5 gms.; Cly Al 2″x⅞, Cover; 5 hrs.; 105; None; Air; Freas
4 14.26; 10 gms.; Cly Al 2½x3-16; 5 hrs.; 102; None; Electric Air; Freas
5 1b.33; 5 gms.; Cly Al 2″x⅞; 4 hrs.; 104; None; Electric Air; Freas
6 14.30; Cly 3″x½, No Cover; 5 hrs.; 101; None; Electric Air; Freas
7 14.34; 10 gms; Cly 2″x⅞; 5 hrs.; 105; None; Electric Air; Freas (Results drying over night, 14.43, 14.50.
8 14.20; 20 gms.; Cly 3½″x¾, No Cover; 8 hrs.; 100; None; Electric Air; Freas
9 14.60; 5 gms.; Cly Al 2″x1, No Cover; 6 hrs.; 104; None; Electric Air; Freas
10 14.34; 5 gms.; Cly 50mmx20mm; 5 hrs.; 103; None; Electric Air; Freas
11 14.46; 5 gms.; Cly 2x⅝, Cover; 7 hrs.; 107; None; Electric Air; Freas
12 14.22; 10-12 gms.; Cly 55mm x 22mm; 16 hrs.; 100;None; Electric Air; Freas
13 14.16; 2-5 gms.; Cly Al 2½x1 3-16; 2 hrs; 105; None; Electric Air; Freas. (Av. of 6 determinations, 4 using 5 gms; 2 using 2 gms.)
14 14.09; 10 gms.; Cly 50mm x 25mm, Cover; 5 hrs.; 103; None; Electric Air; Freas.
15 14.39; 10 gms.; Cly 2x1, Cover; 5 hrs.; 105; None; Electric Air; Freas.
16 13.97; 15 gms.; 2x1½ Cly, Cover; 5 hrs; 105; None; Electric Air; Freas. (Containers covered while weighing, both before and after drying.)
17 14.33; 10 gms; Cly 2x½, Cover; 4 hrs; 102; None; Electric Air; Freas.
18 13.22; 4 gms; Cly Al 1x¾, Cover; 5 hrs; 104; None; Electric Air; Freas.

19 14.38; 5 gms; Cly Al 2x⅞, Cover; 3½ hrs; 105; None; Electric Air; Freas. (Allowed to cool 15 min. before weighing.)

20 13.56; 2 gms; Cly Al 50mm x 14mm; 5 hrs; 105; None; Electric Air; Freas.

21 14.44; 5 gms; Cly Al 5cm x 2cm, Cover; 5 hrs; 103; None; Electric Air; Sargent.

22 14.02; 10 gms; Cly 2 Dia., Cover; 6 hrs; 100; None; Electric Air; Sargent.

23 14.24; 5 gms; Cly Al 2x⅞, Cover; 5 hrs; 101; None; Electric Air; Sargent.

24 14.48; 5 gms; Cly 50mm x 20mm; 4½ hrs; 105; None; Electric Air; Sargent.

25 13.81; 10 gms; Cly 2 Dia, Cover; 5 hrs; 103; None; Electric Air; Sargent. (Av. of 13.72 and 13.90.)

26 14.36; 5 gms; Cly Al 2x⅞, Cover; 5 hrs; 102; None; Electric Air; Sargent

27 14.31; 5 gms; Cly Al 2x⅞, Cover; 4½ hrs; 102; None; Electric Air; Sargent (Unable control temperature exactly.)

28 14.50; 5 gms; Cly 5cm x 4cm; 6 hrs; 103-105; None; Electric Air; Sargent

29 13.87; 5 gms; Cly Al 2x½; 6 hrs; 100; None; Electric Air; Sargent

30 13.60; 5 gms; Cly Al 50mm x 22mm; 6 hrs; Av. 103; None; Electric Air; Sargent. (Temp. varied 102-107. Unable to control.)

31 14.00; 2 gms; Cly 30mm x 50mm; 5 hrs; 110; None; Electric Air; Sargent

32 14.37; 10 gms; Cly 2x⅞; 6 hrs; 105; None; Electric Air; Sargent

33 13.99; 3 gms; Cly Al 55mm x 15mm, Cover; 5 hrs; 103; None; Electric Air; Sargent.

34 ;13.63; 2-3 gms; Cly Al 2½x½, No Cover; 12 hrs; 100; None; Electric Air, Sargent. (Av. of 13.61 to 13.66.)

35 13.95; 5 gms; Cly 2x⅞, Cover; 5 hrs Approx; 105; None; Electric Air; Sargent.

36 13.86; 5 gms; Cly Al 2x3-16, Open; 4 hrrs; 101; None; Electric Airr Sargent

37 14.29; 10 gms; Cly 2x1, Cover; 5 hrs; 101-103; None; Electric Air; DeKhotinsky.

38 14.45; 2 gms; Cly Al 2x¾, Cover; 7 hrs; 108; None; Electric Air; DeKohtinsky.

39 14.44; 5 gms; Cly Al 60mm x 24mm; 6 hrs; 102; None; Electric Air; DeKohtinsky.

40 14.10; 2 gms; Dim. not given; 5 hrs; 105; None; Electric Air; DeKohtinsky

41 14.4 ; 31 gms; Cly Al 4x3-5, No Cover; 8 hrs; 210F; None; Electric Air; DeKohtinsky.

42 14.04; 1.7 gms; Cly Al 2x⅞; 5½ hrs; 101; None; Electric Air; DeKohtinsky

43 13.58; 10 gms; Cly Al 2x⅞; Constant 101; None; Electric Air; DeKohtinsky

44 14.47; 5 gms; Cly Al 5cm x 2.3cm, Cover; 5 hrs; 110; None; Electric Air; Despatch.

45 14.50; 5 gms; Cly 2x⅞; 16 hrs; 110; None; Electric Air; Despatch

46 14.50; 10 gms; Cly Al 2x1; 5 hrs; 102; None; Electric Air; Despatch

47 15.00; 10 gms; Uncovered Al pan; 5 hrs; 212F; None; Electric Air; Despatch

48 14.30; 5 gms; Cly 50mm x 14mm, No cover; 5 hrs; 104; None; Electric Air; Despatch.

49 14.58; 5 gms; Cly Al 2x1; 5 hrs; 105; None; Electric Air; Simplex

50 14.00; 5 gms; Cly Al 2x½; 5 hrs; 100; None; Electric Air; Simplex (Got some results using glass bottle (2 gms) 4x11.)

51 14.21; 10 gms; Cly 2x1; 6 hrs; 101-103; None; Electric Air; Thelco

52 13.50; 10 gms; Flat, No Cover; 5 hrs; 212F; None; Electric Air; Rival

53 13.52; 2 gms; 1x2¾, Cover; 5½ hrs; 102; None; Electric Air; Varsity

54 14.47; 6 gms; Low Form Proc Cruc 15 cc; 5 hrs; 100; None; Electric Air; American.

55 13.36; 5 gms; Cly 4cm x 1¾cm, No Cover; 5 hrs; 105; None; Home made

56 13.64; 5 gms; Cly 2x1½, No cover; 5 hrs, 20 min.; 100; None; Double-walled Water Oven heated with electric hot plate.

57 14.37; 1 gm; Homopathic Vial 6 cm long; 15 hrs; 102; None; Not given

58 13.90; 5 gms; Tin box 2″ Diam., Cover; Over night; Temp. near boiling water; Not given.

59 13.98; 15½ gms; Cly Al 2x1, Cover; 5 hrs; 103-105; None; Electric Air; Freas.

60 14.74; 5 gms; Cly Al 50mm x 22mm, cover; 1½ hrs; 95; 28″; Electric Vacuum; Freas Vacuum.

61 14.38; 5 gms; Al, Cover; No time given; 98; 29″; Vacuum; Freas Vacuum

62 14.43; 2 gms; Glass weighing bottle 50mm x 25mm; 4 hrs; 105; 24″; Vacuum; Freas Vacuum.

63 14.4; 10 gms; CL Al 2½x¾; 1 hr Air at 140, 1 hr Vacuum 140;27″; Vacuum; Freas Vacuum.

64 14.74; 5 gms; Cly 2 3-16 x 5-16, Cover; 5 hrs; 104; 30″; Electric Vacuum; Freas Vacuum.

65 14.20; 2 gms; Balanced watch glasses 2″ diam.; 2½ hrs; 100; 25″; Electric Vacuum; Freas Vacuum.

66 14.63; 2 gms; Cly 1½ diam., cover; 30 min.; 75C; 27″; Electric Vacuum; Mojonnier.

67 14.64; 5 and 2 gms; Cly Al 50mm x 25mm, Cover; 45 min.; 85C; 26½″; Electric Vacuum; Majonnier. (5 gm. sample 14.66: 2 gm sample 14.62.)

68 14.20; 5 gms; Al 2x½, Cover; 90 min.; 80-90C; 26″; Electric Vacuum; Mojonnier. (Av. of 6 determinations made in pairs: 14.4-14.2, 14.2-14.1, 14.3-14.2.)

69 14.10; 1 gm; Cly 2½x½; 5 min.; 135C; 26″; Electric Vacuum; Mojonnier, Latest Type. (Cooled 2½ min. in water cooled desiccator.)

The average of all 69 results was 14.19, distributed between 13.22 and 15.00.

The average of all 59 air ovens was 14.15, ranging from 13.22 to 15.0.

The average of all vacuum ovens was 14.45, ranging from 14.1 to 14.74.

Thus it will be noted that the vacuum ovens gave an average result on the sample of 0.3 of 1% higher. The more extreme variations occurred with the air ovens, there being a difference of 1.78% between the high and low of these, while the like difference with the vacuum ovens was only 0.64.

8 operators using air ovens and samples of 1-4 grams averaged 13.97, low 13.22, high 14.47.

29 operators using air ovens and 5 gm. samples averaged 14.22; low 13.36, high 14.6.

22 operators using air ovens and 10 gm. or larger sample averaged 14.15; low 13.58, high 15.0.

6 operators using regular Freas Vacuum ovens averaged 14.48; low 14.2, high 14.74.

3 operators using Mojonnier Ovens averaged 14.49; low 14.2, high 14.64.

1 operator using Latest model Mojonnier secured a result of 14.1.

About the only definite conclusions we were able to draw from all this data was the fact that we did not know how much moisture the sample of flour contained, and that the laymen unfamiliar with laboratory work would be fully justified in wondering why more concordant results were not obtained on check samples that are now frequently sent around in so-called air-tight sample containers.

Portions from the containers kept in our own laboratory were run from time to time. These separate containers were marked A, B, C, D, etc., and opened consecutively. Sample A was opened first, 2-5 gram samples weighed out, and the container immediately resealed. This was repeated for some time until a number of determinations had been made on the single container; whereupon it wa discarded and the next portion treated in the same manner. Determination was made by drying for six hours at 105 degrees C. All results are the averages of duplicates.

SAMPLE A

	Moisture
Opened 2-28	14.56
Determined 2-28	14.56
Determined 3-6	14.25
Determined 3-7	14.18
Determined 4-15	13.73

SAMPLE B

	Moisture
Opened 4-3	13.96
Determined 4-6	13.94
Determined 4-7	13.90
Determined 4-8	13.98
Determined 4-10	13.96
Determined 4-11	13.90
Determined 4-12	13.61
Determined 4-25	13.37

SAMPLE C

	Moisture
Opened 4-18	14.05
Determined 4-19	14.13
Determined 4-20	13.92
Determined 4-21	13.73
Determined 4-22	13.62
Determined 4-25	13.32

SAMPLE D

	Moisture
Opened 4-28	13.89
Determined 4-29	13.87
Determined 5-3	13.68
Determined 5-4	13.74
Determined 5-10	13.76
Determined 5-11	13.46
Determined 5-16	13.28

Note that these later samples as opened showed a much lower moisture content than the first ones. Although the decrease is rather irregular, Sample D shows o loss of 0.67% in a little more than 2 months. After opening and resealing all the samples showed a regular defenite loss, which became more pronounced as the container became nearer empty. However, the loss of 0.67 in two months does not explain the extremely low results obtained by some laboratories. Our own samples were subjected to extreme treatment, as they were kept in the warm laboratory during the entire period. Most of the 69 results were reported in less than 10 days.

We then carried out some work to bring out forcibly the factors that will cause a variation in the amount of moisture determined. All results listed from here on are the average of two or more determinations. The containers were weighed empty, approximately the amount of flour desired for the test was dumped in, the cover replaced, and the container immediately weighed. Extreme care was taken to make the different comparisons on exactly similar samples. However, we found it impractical to make all the different determinations on the same sample. For this reason the flour sample used in the comparisons under each sub-heading following is different as will be noted from the results. Cylindrical aluminum containers 2″ x ⅞ with covers were used except as noted.

No. 1 Effect of Slow Weighing and Leaving Sample Uncovered.
Laboratory Temperature 74 F; Relative Humidity 56%

	Moisture	Loss
Sample	13.61	
Sample uncovered 5 min.	13.54	0.07
Sample uncovered 30 min.	13.29	0.32
Sample uncovered 60 min.	13.19	0.42

No. 2. Effect of Improper Desiccation.

			Moisture Loss (Approx.)	*As weighed after standing 1 week in desiccator containing slightly diluted sulphuric acid*
Weighed Hot	13.92			13.45
Cooled 5 minutes	13.80	0.12		13.49
Cooled 10 minutes	13.76	0.16		13.49
Cooled 30 minutes	13.74	0.18		13.46
Cooled 60 minutes	13.76	0.16		13.54

No. 3. Effect of Drying at Different Temperatures. Similar Samples.

	100°C	105°C	110°C
6 Hrs.	13.45	13.72	13.77
24 Hrs.	13.57	13.75	13.81

No. 4. Effect of Different Locations in Oven. Similar Samples.

	Moisture 6 Hrs.	*24 Hrs.*
100°C		
Top Shelf (Thermometer Bulb oven with flour sample)	14.17	14.26
Shelf about 6″ lower	14.33	14.39
Difference	0.16	0.13
105°C		
Top Shelf (Thermometer Bulb oven with flour sample)	14.21	14.33
Shelf about 6″ lower	14.36	14.38
Difference	0.15	0.15
110°C		
Top Shelf (Thermometer Bulb oven with flour sample)	14.42	14.38
Shelf about 6″ lower	14.49	14.51
Difference	.07	.13

No. 5. Effect of using Different Sized Samples.

Aluminum cans 2″ x 7/8 with covers. Temperature 101°C

	1 gram	5 grams	25 grams
6 Hrs.	14.93	15.23	14.86
24 Hrs.	15.16	15.45	15.14

Aluminum can 2″ x 7/8 with covers. Temperature 105°C

	1 gram	5 grams	25 grams
6 Hrs.	13.17	13.66	13.15
24 Hrs.	13.66	13.92	13.81

Aluminum can 2″ x 7/8 with covers. Temperature 110°C

	1 gram	5 grams	25 grams
6 Hrs.	13.19	13.53	13.15
24 Hrs.	13.21	13.56	13.52

Tin cans 3" x 1 with covers. Temperature 105°C

	1 gram	5 grams	25 grams
6 Hrs.	13.02	13.57	13.65
24 Hrs.	13.06	13.65	13.67

Note the circumstance that the 5 gram in three cases out of four gave a higher result than either the 1 gram or the 25 gram sample.

No. 6. The Effect of Using Different Containers.

Porcelain crucibles, tall form 1" x 1. Loose cover 13.22 ---

	6 Hrs.	24 Hrs.
Porcelain crucibles, tall form 1" x 1" loose cover	13.22	13.26
Aluminum 3" x 1/2, No covers	13.47	13.52
Aluminum 2" x 7/8, Covers	13.54	13.53
Tin 3" x 1", Covers	13.53	13.73

CONCLUSIONS

In order that different flour mill laboratories obtain similar results on the same flour sample, following should be kept in mind:

a. Samples should be sent out in absolutely air tight containers; containers should be insulated against heat if possible. Determination should be made at once after receiving sample. So called air tight samples apparently lose moisture.

b. Laboratories using air ovens and vacuum ovens cannot check between one another; vacuum oven gives higher results.

c. Grab samples should be used instead of a definite amount. That is, empty container is weighed, approximately the amount of sample desired dumped in, cover replaced, and gross weight obtained, in preference to balancing the weights by putting flour in container while same is on scale pan. Sample loses rapidly when exposed to dry air. In the use of air ovens, the shape, size, and material of container should be standardized. Shape and size of container influence the loss on drying.

d. In the use of air ovens, the approximate weight of sample taken should be standardized. Five grams seems the most desirable since it is in quite general use. One gram sample and 25 gram sample both give slightly lower results. Note our own work, also the averages of the laboratories reporting on the check sample.

e. In the use of air ovens *Temperature and Time of Drying should both be standardized within close limits.* Temperature range permitted should not be over 2°, and time of drying adhered to very closely.

f. More than usual care should be taken to observe the ordinary precautions of analytical work, such as having thermometer bulb exactly on a level with flour samples, keeping strong acid in desiccator, allow sample containers to thoroughly cool beforre weighing, etc., as the failure to observe these simple matters is the only plausible explanation we have for some of the results on the check sample.

The Kansas Milling Co., Wichita, Kansas.

FLOUR BLEACHING REAGENTS

By Dr. J. C. Baker

The bleaching of flour began in England about twenty years ago when the Andrews patents were first operated, using nitrogen tetroxide generated from nitric acid. The electrical method of generating nitrogen teroxide was soon found more convenient and rapidly spread over many countries, including the United States, as a method of improving the color of flour. This compound was the only commercially successful one until the use of chlorine and nitrosyl chloride was advocated by Wesener. This method of bleaching and maturing flour was rapidly extended in the United States by the Industrial Appliance Company. Later chlorine was applied by other concerns and has attained a wide use in this country.

Various other methods of bleaching have come into use of recent years. The combination use of chlorine and Alsop has had wide application in many mills. The reason for the use of this double method is that it yields whiter flour than can be obtained by either alone.

Other new processes in use are those of Fegan and Sasse, Novadel, Salox and lastly and the newest of them all comes the use of Agene, or nitrogen trichloride.

It is notable that with but one exception, all the methods of bleaching named use compounds containing nitrogen or chlorine, and four of the methods use compounds or combinations that include both nitrogen and chlorine. A further point of interest is found in the fact that nitrogen tetroxide, nitrosyl chloride and nitrogen trichloride contain nitrogen in the same degree of oxidation.

The active agent in "The Agene Process", nitrogen trichloride, or NCL^3, was discovered by Sir Humphrey Davy and has never before been used commercially. About three years ago, while investigating the properties of this compound as a possible sterilizing agent, its bleaching properties were tried on various substances. Upon applying the gas to flour, a quick and brilliant white was immediately produced. This was followed by baking tests and other investigations to find the best method of production and application of the gas. Within three months after the discovery of this property of the gas, a large mill was successfully using the process.

Agene is nitrogen trichloride diluted with humidified air. It is generated by combining chlorine dissolved in water with an ammonium compound dissolved in water. The two substances react to form nitrogen trichloride, which is very readily removed from the water by a current of air. This is done by passing the solution downward through a tower filled with marbles, and blowing a current of air upwards, completely removing the compound from solution. It is then passed to the flour in an agitator.

The process can be operated, if desired, to produce a mixture of nitrogen trichloride and chlorine gases. This may be used in case an increase in acidity or water soluble solids and nitrogen is desired. However, in general, pure agene gas gives the best results.

The apparatus for generating and applying agene gas was developed rapidly and tried in various mills in this country and Canada until the perfected equipment was ready and placed on the market a year ago.

The reactions by which nitrogen trichloride is formed are as follows: The chlorine, when dissolved in water, forms hydrochloric acid, and hypochlorous acid—the ammonium compound reacts with the hyprochlorous

acid only so that one half of the chlorine used in manufacturing the compound goes to form hydrochloric acid, which remains in the water and goes to waste. Thus only one half of the weight of the chlorine used in the agene process reaches the flour, also an equivalent amount of nitrogen reaches the flour.

Nitrogen trichloride applied to flour reverses its reaction of formation nearly quantitatively, so that the products are chiefly hydrochloric acid from the chlorine present and ammonia from the nitrogen present.

The amount of nitrogen trichloride required to bleach hard wheat, bread-making flour, varies from $1\frac{1}{2}$ to 5 grams per barrel, in treating all grades of patents, straights, clears and low grades, although some of the low grade flours may take a little more. These are practically the limits. In the case of a 2 gram treatment with agene on the patent flour, we are using 1-7 of one ounce of chlorine, and putting into the flour 1-14 of one ounce. To express the treatment in parts per million, the weight of nitrogen trichloride or the weight of the hydrochloric acid formed rather is from 11 to 55 parts per million, as the rate varies from one gram to five grams per barrel.

There is a small portion of the nitrogen trichloride which does not go through the reaction to hydrochloric acid and ammonia. I do not know definitely what becomes of it, but am able to find in the treated flour very minute traces of nitrites, particularly in the higher rates of treatment. There is also a very minute trace of chloride can be detected in the oil at the higher rates of treatment. This is doubtless combined with the carrotin.

The most important point in any bleaching process is its effect upon the bread. What does nitrogen trichloride do? Its first and most characteristic property, as Mr. Weaver stated in his paper before the association of operative millers, is the removal of color. It has very powerful color removing properties. It is capable with patent flour, at the rates given, of removing every trace of gasoline soluble color, so that a gasoline extract of the treated flour can be produced which is colorless, or any other stage of color removal can be obtained by altering the amount of gas applied.

It is possible to obtain slight further improvement than the gasoline extraction would indicate. After all color removal is completed as indicated by gasoline extraction, and one adds more of the compound, further color improvement obtains in the dry flour and also in the wet and dry slick. The reason for this is not clear. It is not a reaction on the fiber or upon the coloring materials contained in the particles of bran, possibly there is a minute amount of color which acts as an indicator, and is influenced by the increasing amount of acidity.

Agene, after applying to flour, does not appreciably alter, by the ordinary methods of determination, the ash content, acidity, wet gluten, dry gluten, total protein, water solubles or soluble protein.

The properties which it does alter are those of color, texture, loaf volume in the ordinary method of baking, and all other characteristics which are associated with a loaf made from matured or aged flour.

The acidity of the flour is not appreciably increased, although by very careful work one can detect an increase as the rates of application are increased above one and two grams to three, four, five, or six grams, although

it is very minute. The amount actually added varies from 11 to 55 parts per million of hydrochloric acid within the ordinary range of treatment.

By taking untreated flour and adding hydrochloric acid in these amounts and examining the gluten and loaf for their properties, the baking results are parallel and similar to agene treated flour in all respects except color. The gluten, after treating with nitrogen trichloride or hydrochloric acid in equivalent amounts, has a softer and easier working feel, which is indicated in the viscosity and which shows its properties so remarkably in baking a loaf of bread.

There is much more acid added in bleaching with chlorine than with agene, though the baking results are very similar. The reason for this difference is found in the increased buffer action caused by the addition of chlorine. The amount of acid which needs to be developed during fermentation to bring the final hydrogen ion to *p*H5 is practically the same in both cases. The shortening of the fermentation period which occurs in baking Agene treated flour, is approximately fifteen minutes, and is about the same as obtained from the use of chlorine. It takes about as long for the yeast and lactic acid producing organisms present to develop the proper amount of acid to bring the *p*H to its optimum point, in each case.

Now to continue with the other properties. The subject of acidity was given first because so much depends upon it.

With patent flours in our baking laboratories, and many other laboratories, we have found a constant increase in volume of from one up to five, and even ten per cent. On clear flours the increases are more marked. After treating with Agene we find clear flours give usually as large a loaf as patent flours from the same wheat. The results are very remarkable on clear grades.

Though loaf volume is increased by bleaching, the baker can handle untreated patent flour so as to get volume which is equal to that from the same flour treated by any process. With untreated flour one can, with proper handling and longer fermentation to permit the acidity to develop, get volume. But the baker doesn't do this, and that is where the importance of loaf volume increase from bleaching comes in. The baker has his standard procedure, and he wants to work as fast as possible. It is a great advantage to him to get greater loaf volume results in a short time.

With clears and low grade flours, one cannot by proper handling, obtain as large a loaf volume with the untreated as with the treated flour. There are present so many organisms, enzyme and other things that interfere and break down the gluten before development can reach the point of optimum baking, that the maximum is never reached which can be obtained in the shortened fermentation period of a treated flour. The question of the keeping quality after treatment is of great importance. Such experiments have been carried on eleven months. Other work has kept us from making many keeping-quality experiments, so we have used the work of the various mills who have had the process in operation and have made these experiments themselves. There are results in one mill of eleven months; in another mill of six months and another mill of nine months. In no case, at the end of that time, had there been found a falling-off of volume and other qualities of the loaf. The acidity increases regularly during ageing. No injurious effect of the bleaching has been found.

In closing, Mr. Lawellin requested a few remarks that applied to the subject of bleaching in general and its relation to the public.

The bleaching of flour has been very severely criticized, been attacked from every quarter, and much agitation has been put forth against it. I want to repeat to you some reasons for bleaching flour.

From the miller's standpoint flour is bleached because it enables him to avoid storage. It enables him to handle the new crop advantageously. He can standardize his product, so that with the varying colors of wheats he can put out a uniform grade of flour. These considerations, important as they may be, are of very minor value as compared to the real dominant reason for bleaching flour.

The people of the world, not only the American people, have an inherent, dominant, insistent love of whiteness. It signifies purity. It exists as a human trait and has always existed. The history of the milling industry from its very inception is a history of effort to improve the whiteness of the flour by varying milling procedures, such as tempering, re-bolting, shortening the patent, and all sorts of devices to make the flour whiter. When bleaching came into use it enabled the miller to turn out white flour with very much greater ease than he had been able to do before.

Suppose for a moment that bleaching were prohibited in this country. Let us see what would happen. You probably will not agree with me, some of you at least, but I am very certain it would happen. Demand for white bread will exist just the same as before. People will have white flour and the miller will be compelled to furnish it. He can obtain it in only three ways: by buying higher grades (whiter wheat), or by shortening his patent, or by substituting softer white wheat. He will have to do one of those three things to get whiter flour, and if he substitutes whiter wheat he either supplies an inferior product or increases the cost to the consumer; if he shortens his patent it increases the cost to the consumer, and in both cases he may reduce the body building materials in the flour. These are reasons for bleaching.

There is one other reason probably as great as those. If bleaching were prohibited in this country, the use of yellow wheats would become a tremendous handicap. This great Southwestern Empire owes one great portion of its development to the beginning of flour bleaching. If you will examine the market records, you will find the yellow wheat of this region steadily increased in its price as related to white wheat, through all this development of bleaching, until today yellow wheat has a very high value. Eliminate bleaching and what will happen to the value of yellow wheat? What will happen to the farmers of this Southwestern Empire? It will come to the point where the wheat will have to be sold at a discount. A great hardship will be worked on the regions that can produce yellow wheat.

In closing I want to state that the bleaching of flour is of great value to humanity, because it lessens the cost of a thing they want and need, and it increases the areas in which it can be produced. I thank you.

Wallace and Tiernan Co., Newark, N. J.

MILLER-CHEMIST-BAKER, ACQUAINTED

By R. Wallace Mitchell

Friends, it may seem to you that to drop out of laboratory work as I done would mean to more or less lose interest in the things that are responsible for our Association. With me it has not been so; rather, it has made more clear to me the need of further effort as a body. It has had the effect of setting me off as it were, where I have been able to get a better perspective of the conditions and the relations that exist with us as chemists in the cereal industries. It has emphasized many phases of our work; but what I want to bring to your attention today is the importance of our opening our eyes to some conditions outside of the laboratory that spell either progress or decay, depending upon the manner in which we treat them. These conditions to my mind are right now making felt the need of a new element in the business relations of miller and baker and I think I will most clearly express myself by calling that factor, "Chemist-Baker". By that I mean you to understand, a cereal chemist who has really practical knowledge of commercial baking.

Let us look back a little and review the development of our present day milling laboratory. Twenty years ago the milling chemist was primarily an analyst and he was a very detached unit of the flour milling organization, if we may go so far as to grant that he was in any sense a member of the organization at all. He was in most all cases a commercial chemist with his interest divided not alone between various mills but also among numerous enterprises that were entirely distinct from cereal lines.

A dozen years ago there developed a pronounced trend toward the "Milling Control" chemist. This was a big step in the right direction as it made possible the more intensive application of science to manufacturing experience, and warranted a steady development in the same direction in every year to date. It was a happy step for the miller and has had the effect of raising the standards of the industry as a whole.

Both the grain industry and the commercial baking business have been beneficially influenced thru the advancements made by the milling chemists and the milling industry as a whole. The grain and baking industries have both gradually come to accept as a matter of course, many of the conditions established thru the application of chemical science to the manufacture and sale of flour. On the other hand, the present day finds it common practise for the grain merchant to quote his price product as of definite moisture content, protein content, and origin, and closely graded as to class and purity, while on the other hand the baker now recognizes that there are other factors to be considered beside the question of whether his flour is "spring or winter."

The baker has taken his cue from the miller and is coming to accept chemical control in the matter of purity, adaptability, and value in the selection of his raw materials. A most encouraging developement is the step that the baking industry is now taking in introducing chemical control in plant operations, it cannot fail to be a factor of great importance in the great strides that the craft is making in the present day.

Now then! I ask you, "What is the significance of this trend?" Do you not see that the time is here when the milling industry must de-

velope a new bond between miller and baker? My message to you today is this,—Point out to your mill managers the golden opportunity that is theirs to secure a more firm hold on the confidence of their baker trade, by a most commendable means. That is, foster the personal feeling between mill and bakery by sending a representative to call on the baker, who can talk bake-shop language, who can really bake good bread under shop conditions, and who knows the technical problems in both the mill and the bakery. Such a man can do much good for both the baker and the miller, he can help both because he can return to the mill and apply the information that he has gained from the baker and in this way build on both ends. Such a function can not be discharged by any element in either organization so well as by the milling chemist. You are the men upon whom this work must fall. Such a course, if pursued, means the development of a new phase in the mill organization and it means that your experience must be broadened to meet the new conditions that would be imposed upon you.

Under existing conditions the mill chemist only gets acquainted with the baker when there is trouble to be overcome. He is received by the baker as the 'goat,' sent out to convince him that 'black is white.' With such a psychological handicap and an equally depressing handicap of ignorance of bake-shop technique, what chance has a good flour, to say nothing about one that may need a little careful handling? Such has been the experience of the "mill-chemist" in the past and is so today to a large extent. It can only be changed by some such effort as I am recommending to you today. It needs no argument to persuade you that if chemist and baker take issues over a difficulty, the matter becomes a problem and will unquestionably be solved.

The responsibility of the mill management is equal to yours in the development of better conditions but the encouraging feature in that respect is that they can reap a profit by developing the new field of effort. There is no question but that a mill that will offer and can render a genuine bakers' service to the trade will profit immensely. Such a service will inspire confidence on the part of the baker and confidence we all know is a companion to quality in measuring the strength of the bond between mill and bakery. It would be very interesting to discuss some of the details of such a service but that would take too much of our time today.

There will be objections raised by mill managers to such an innovation as I am proposing. The first one will be, "too expensive"; that is what some timid millers said when they realized that the maintenance of a laboratory would cost them from 3 cents to 5 cents per barrel of flour capacity. They know better now. Then there will be the argument that it will take the chemist away from his duties too much. To that I can only say that the manager who measures the value of his chemical force by the volume of data turned in on the daily report, is not getting the most out of his investment. Others will say that the time is not here for such a departure. and to this contention we can only point out that there are mills already in the field with a service for the baker, especially the small baker who can profit by the more restricted service that the mills are now able to render. In this connection it is worthy to note that the ones first to develop the control laboratory are the very ones which are now forming service departments. They are preparing to meet the demands of tomorrow

just as they were meeting the new demands that conditions made profitable ten years ago.

There will be objections raised by some of you sitting here today, you will say that to be a baker and chemist too is taking in too much territory, that your training has been directed to making chemists and not ambassadors. Well, my idea of the function of a chemist is that he should give all the service that his training makes possible, to his employer. We should make it a part of his training to know the practical end of the baking game just as he has found it essential to know some of the practical elements in grain buying such as, for instance, the relation of wheat quality to origin.

You may ask the question, "Is the baker ready to accept the service of the mill in the problems of his shop?" The answer is that each day sees the growth in the number of bakers having a scientific knowledge of the problems of the baking process. The old rule-of-thumb bakers are becoming each day more scarce, and trained bakers, that is, scientifically trained bakers, are growing in numbers constantly. Tomorrow the majority of bakers will be appraising their raw materials in terms of chemical data solving their shop problems in the light of definite knowledge of fermentation.

On all sides we meet evidence of the approach of the newer day. Even old time bakers who might be justified in scoffing (gray hairs and a life time of experience would justify such action if anything would) are treating technical information and expert opinions with both interest and respect. These men, whether journeymen or employers, are anxious to add to their experience some of the knowledge that the young man out of the baking school of today is finding so profitable.

The baker of today with technical training and practical experience knows how to interpret a chemical analysis, he knows the function and the properties of all the ingredients of a dough batch as well as the principles involved in fermentation. He is disinclined to accept generalities and unsupported claims as a basis of considering the merits of his materials. With him, a good fellow, a cigar, and sentiment are secondary to the facts supported by science. Such a man will be not only willing but glad to sit down and discuss the problems of the shop with the mill chemist who is versed in the knowledge of the baking business.

Friends, such is the handwriting on the wall, there can be but one interpretation. The successful miller of tomorrow is going to be the one who supplies the link that will most effectively bind the new generation baker to himself. The miller's only solution is the Chemist-Baker. It will avail nothing to attempt to accomplish our aim by giving a flour salesman a dose of chemistry—the fact that he is known to be a salesman is his handicap because there is a natural doubt of his ability to talk with authority on technical phases of milling and baking. The only solution is the broadening of the training and sphere of influence of the mill chemist. He it is who has the scientific training and the practical experience necessary to be the intermediary in the new relation of miller and baker. The broader and more practical is the chemist's baking experience the more valuable he will be to his employer. To this end it will be essential that the mill management extend to the chemist the opportunity of meeting and working with the mill's baker customers—AT ALL TIMES, not just in times of "grief".

On our part, it is well to be reminded again—WE MUST PREPARE.

A college degree has about as much influence on a cantankerous dough as kind words do on a mule. A barrel stave helps in one case but baking experience means half the fight in the other. It is ruinous waste of time and money to put green hands at the service of expensive brains, just, so, there is little profit in sending a man from the mill to solve a flour difficulty in a bake shop and have him be defeated by his own lack of shop training. We must prepare ourselves by applying our efforts to gaining a practical knowledge of bake shop practice and until we do so we will be in no position to assume our share of the burden that the new conditions have imposed upon us.

I trust that you will not accept my few words as an idle dream. I have tried to call to your attention what appears to me to be the crying need of the day that is, more effective means of attaining close co-operation between miller and baker. Because progress in both milling and baking in the last fifteen years has been more pronouncedly of a chemical nature the chemist is by force of circumstance the key to the situation now. A great responsibility rests upon both miller and chemist and if both respond with a will to meet the emergency there will develop a most satisfactory inter-relation in the industries involved.

American Baking Material Co.

FLOUR STRENGTH

By H. A. Weaver and W. A. Goldtrap

What is a strong flour. A definition which defines a strong flour nearly always states what kind of bread can be made from the flour.

The most popular definition, we believe, is this: A strong flour is one capable of being baked into large, well piled loaves.

The chemical and physical properties a flour should possess to yield bread of this character have been a matter of investigation among millers, bakers, and their chemists, as far back probably as the time when it was first discovered that all flours were not alike.

As early as 1750 it was known that gluten could be washed out from wheat flour, when a dough made from the latter was kneaded under water. For a long time it was even commonly assumed that a flour containing the most gluten was the strongest flour and much effort was expended to determine the percentage of gluten by analytical methods.

After extended work it was almost universally agreed that the per cent of gluten contained in a flour was not the sole factor determining flour strength; even today however, such a supposition finds place in the popular mind.

Further investigation concerned itself with the composition of gluten. Osborne and Voorhees discovered that gluten was made up of two protein bodies—gliadin, which is soluble in 70% alcohol; and glutenin, which is not. Many investigators have attached great importance to the gliadin-glutenin ratio, 75:25, 64:36, and 60:40 are some of the ratios given as essential for a strong baking flour. Other investigators denied that any particular gliadin-glutenin ratio was necessary for the production of a strong flour.

It is well established today that the gliadin-glutenin ratio is not the deciding factor of flour strength although it cannot be denied that the

ratio of these two substances to one another, when considered with other analytical data, deserve consideration.

The percentage of sugars which a flour contains has been investigated and the claim made that flours containing the largest amounts of this substance were capable of producing the largest loaves. This has been denied by other investigators, who bring forward flours made from sprouted and unsound wheat, which are high in sugars but weak in performance, to refute their claims.

All are now agreed that the percentage of sugars which a flour contains is not a measure of that flour's strength. The function of sugars during the fermentation of doughs made from wheat flour is of course fully recognized.

The percentage of total to soluble proteins have been investigated and some investigators have found that a relatively high percentage of soluble to total protein means an easy working, elastic dough, which will produce bread of good texture and volume, using a short fermentation period. It has also been found that too high a percentage of the soluble protein means an entire breaking down of the proteins and unfits a flour for bread making purposes.

The ratio of total protein to soluble protein can be used to advantage when considered with other analytical data, but no one would care to judge a flour solely by this ratio.

A further study concerning the formation of gluten was brought forward by Wood and Hardy. These investigators were among the first, if not the first, to make the claim that the difference in the coherence, elasticity and water absorbing power observed in gluten washed from various flours was due to the varying concentrations of acids and soluble salts rather than to any intrinsic difference in the composition of the glutens themselves.

Along these lines Hardy[1] speaks as follows: "Now gluten, even though it be prepared from the best Fife Flour, has of itself neither ductility nor tenacity. In the presence of ordinary distilled water it partly dissolves, the residue—the larger portion—forming a semi-fluid sediment destitute of tenacity. Why? Because tenacity and ductility are properties impressed on gluten by something else, namely: by salts, by electrolytes, that is, which may be organic and may therefore be represented in an ash analysis. This being the case it is obvious that any attempt to co-relate strength with the properties of gluten washed out in the ordinary way must end in failure since the properties of washed gluten depend upon the electrolytes, which happen to be left in after the washing is concluded.

Jessen-Hansen[2] found that a flour baked best when its dough had a hydrogen ion concentration of approximately pH5.

To quote him: "—for the dough of any wheat flour, there exists a determined concentration of hydrogen ions, with which the production of bread from this flour will be most successful, and this concentration is greater than that which is found in a dough made from the flour in question freshly milled and prepared with pure distilled water or fresh milk.

This optimum concentration corresponds approximately to the exponent of hydrogen ions pH5. For choice flours this appears to be a little higher. For the ordinary or bad kinds, on the contrary, it is slightly lower."

Just at the present time hydrogen ions have become more or less of a

fad and some of the trade papers have carried articles which stated that the hydrogen ion concentration of a flour was the determining factor in flour quality.

While we recognize the importance of hydrogen ion concentration as a factor in determining flour strength, we do not admit it is the sole factor of flour strength.

Certainly Jessen-Hansen never intended to convey this impression. To quote him again in one of his closing paragraphs he says: "May I be permitted to observe in closing that these experiments which I have just described constitute fundamentally only one part of a more extended piece of work of which the goal is to determine the co-relation existing between the chemical composition of flour and its baking value."

In Jessen-Hansen's work there are many instances given of the action of acids on gluten, bearing out the contentions of Wood-Hardy.

Ostwald & Luers[3] have suggested that flour strength is a matter of the colloidal properties of the gluten, and have made investigations determining the viscosity of dilute dough solutions. They have been able to show the effects of acids, salts and bases on the colloidal swelling of the glutens, again agreeing on the effects that the action of electrolytes have on the properties of gluten.

In all the investigations cited above, gluten has been given a prominent place, although the exact percentage of this substance and its actual composition has given away more and more to an investigation of the outside things which affect its qualities.

Believing that everything brought out by the researches cited above has at least some bearing on flour strength, and that no one thing alone determines the strength of flour, we determined upon a complete analysis of flours and a series of baking tests to determine as far as possible the relations existing between analytical data and the strength of flour, bearing in mind always the assertion of Jessen-Hansen concerning the optimum concentration of hydrogen ions at which the dough made from any flour did its best work, and the suggestion of Ostwald & Luers that an optimum viscosity for the dough at which any flour will do its best also exists.

EXPERIMENTAL PART

A great many different flours have been investigated in this work but we only set forth the results obtained on a few as they are typical of all.

The flours investigated are divided into the following classes: Hard winters, Hard springs, Soft winters, White clubs and Durums. As a preliminary we selected a hard winter wheat patent, straight and clear, a hard spring wheat patent, straight and clear, a soft winter wheat patent, straight and clear. These were all baked, using the same formula, same fermentation period, and the same amount of added water for all. That the absorption varied somewhat we of course realize, but we gave them all the same for the sake of comparison. The formula used was as follows:

Flour, 500 grams; Sugar, 10 grams; Salt, 8 grams; Yeast, 10 grams; Lard, 5 grams; Water, 300 grams.

The fermentation period was as follows: 2½ hours from the mixer to the first punch, 1 hour to the second punch, 1 hour to the pans, proofed until in the judgment of the baker they were ready for the oven, thirty-five

to forty minutes actual time consumed. Baked 40 minutes in an electrical oven. The marks on the baked loaves follow:

Kind of Flour	*Loaf Volume in cc.*	*Color*	*Texture*
Hard wheat patent	2480	101	100
Hard wheat Straight	2550	100	100
Hard wheat Clear	2300	95	96
Spring wheat Patent	2500	100	100
Spring wheat Straight	2400	98	100
Spring wheat Clear	1800	90	90
Soft wheat Patent	1800	98	95
Soft wheat Straight	2200	100	98
Soft wheat Clear	2480	101	100

Here certainly is a vast difference shown in the capabilities of these flours to make large well piled loaves.

Now, we will study the analysis of these flours in order to find out what light analytical data throws on the subject. See Table I.

An examination of the data outlined shows that the different flours show not only considerable difference in their chemical composition but in their colloidal actions as well.

There is a vast difference in the viscosity shown. The highest shown is the Hard Winter Wheat Patent 70.8 seconds and the lowest is the Soft Winter Wheat Patent 46.4 seconds. The difference in the behavior of the different flours in the presence of acid shows also a wide difference, the greatest swelling being shown in the Hard Winter Wheat Patent, the least in the clears of any of the different kinds of flour, where no action whatever is shown.

Obviously a flour showing a low viscosity will not absorb the water one having a high viscosity will absorb. One of the first steps then, in rebaking these flours should be to start with the correct absorption. It was determined to bring our dough to a certain viscosity rather than start with the same amount of water. The viscosity gave us an idea as to what variations would be needed. It took a great many trials, but we believe we finally arrived at the correct absorption for each flour.

Of even greater importance was the difference in viscosity in the flour with water and the flour with acid, these differences we felt gave an indication as to how quickly the gluten in the flour will condition, during the fermentation process. Those which are acted upon quickly will require a short fermentation; those which are acted upon more slowly require a longer fermentation.

Along the same lines it was noticed that the difference in pH registered when 10 cc of N-50 lactic acid was added to the extract, was not always the same; for example, the original pH of the hard winter wheat patent is 5.808 with added acid 4.556, a difference of 1.252. The original pH of the Spring Wheat Clear is shown to be 6.348, with added acid, 5.658, a difference of .690. Evidently if a dough is to be brought to approximately pH5 before it is in the best condition for baking, anything that prevents the approach of this hydrogen ion concentration is going to have to be overcome and this means a longer fermentation period. Just to have a figure to guide us we have multiplied the difference in pH as determined with

TABLE I.

	Moisture	Ash	Protein	Soluble Protein	Ratio	Gliadin	Ratio	Diastatic Value	Acidity	pH	pH using 10 cc N/50 Lactic acid	Viscosity	Viscosity using N/100 lactic acid
Hard winter wheat patent ----	12.73	.373	10.76	2.22	21.5	6.68	62.1	12.5	.076	5.808	4.556	70.8	149.4
Hard winter wheat straight --	12.18	.450	11.08	2.08	18.7	6.68	60.5	14.7	.081	6.062	4.872	66.2	117.4
Hard winter wheat clear -----	12.01	.650	12.84	1.64	12.8	7.12	55.4	24.6	.144	6.268	5.306	64.2	64.2
Hard spring wheat patent ----	12.53	.407	11.80	2.10	17.1	6.98	59.1	8.3	.076	5.858	4.843	58.5	95.0
Hard spring wheat straight --	12.24	.523	12.04	1.76	14.6	7.24	60.0	16.6	.090	6.010	5.063	59.0	69.8
Hard spring wheat clear -----	12.62	.847	13.32	1.72	12.9	8.00	60.0	31.4	.148	6.348	5.658	57.9	56.8
Soft winter wheat patent ----	11.03	.350	9.16	2.34	25.5	6.02	65.7	16.0	.090	5.756	4.450	46.4	79.3
Soft winter wheat straight --	10.97	.413	9.40	1.96	20.9	6.00	63.9	17.8	.090	5.959	4.691	49.8	65.6
Soft winter wheat clear -----	11.31	.783	11.88	1.34	11.3	6.78	56.2	20.2	.171	6.128	4.961	63.3	62.2

water and that determined with added acid by ten, and term this the buffer value of the flour.

Thus with the hard wheat patent, 1.252 times 10 equals 12.52, buffer value of the patent. For the Spring Wheat Clear we have .690 times 10 equals 6.90, buffer value. Using this plan the higher the figure the more lightly buffered is the flour, the lower this figure the more heavily buffered the flour.

Our experiments have taught us that there is a certain group of factors which denote a longer or shorter fermentation as follows: The higher the percentage of protein the longer the fermentation; the lower the soluble protein ratio, the longer the fermentation. The same may be said of gliadin although it is not quite so pronounced. The more heavily buffered the flour the longer the fermentation; the less swelling shown by the addition of acid for the viscosity determination the longer the fermentation. We were not able at first to say exactly just what fermentation period or what absorption a flour required. But after several trials we were able to rebake our flours as follows. The formula, with the exception of water, was not changed.

TABLE II.

Kind of Flour	Absorption	Fermentation Time	Loaf Vol. in cc.	Color	Texture
Hard wheat patent	61%	4 hrs.	2600	102	101
Hard wheat straight	60%	4¾ hrs.	2600	100	100
Hard wheat clear	60%	5¼ hrs.	2600	95	99
Spring wheat patent	58%	5 hrs.	2600	101	101
Spring wheat str'ght	58%	5¼ hrs.	2640	98	100
Spring wheat clear	58%	6 hrs.	2580	94	99
Soft wheat patent	53%	3 hrs.	2600	104	101
Soft wheat straight	55%	3½ hrs.	2600	100	100
Soft wheat clear	57%	4¼ hrs.	2520	96	99

The trials referred to have reference to fermenting dough and determining the hydrogen ion concentration and viscosity until we have reached the optimum. See Table II.

It will be noticed that all of these flours made large, well piled loaves and we conclude from the results of our experiments that the words "strong" and "weak" flours are very often misused and a flour of long or short fermentation period should take its place.

Any one of the flours tested is capable of making a good load of bread with a large volume, good pile and texture. It all seems to be a matter of starting with the right absorption and finding the correct fermentation period.

We have examined a great number of spring wheat, soft winter wheat and hard wheat flours and after some experience could estimate the fermentation period for a given formula fairly accurately from the analysis.

Two classes of flour however we were unable to bake. The first of these was a flour made from White Club Wheat. A partial analysis of this flour is as follows:

Moisture 12%, Ash .440%, Protein 9.24%, Acidity 0.09%, *p*H 6.460%, *p*H with acid 5.088, Buffer value 13.78; Viscosity with water 50.8; with acid 42.6 sec.

We varied the fermentation on this flour from 15 minutes to five hours but without results. Some very interesting points are noted. First,

the flour has a very high initial pH—it is a flour very lightly buffered. The viscosity shows that the flour, instead of swelling when acid is added, does just the reverse; and the viscosity is lowered rather than increased. The initial pH of the dough was 6.22, which drops to 5.2 after one hour's fermentation. The original viscosity was 56 seconds, which drops to 42 seconds after one hour's fermentation. Evidently here is a flour whose gluten is not sufficiently protected from the action of the acids formed during fermentation, to allow sufficient gas to be retained to raise the dough mass properly.

By the time the gas is formed the gluten is disintegrated and will not hold it. Probably something could be added to the dough batch which would act as a protector for the gluten against this rapid action of the acid; but in this work we have confided ourselves to the action of natural flours, using only those most common ingredients found in the dough batch, namely: flours, salt, sugar, yeast, lard and water.

Another sample of great interest was a sample of Durum flour. Among other things the analysis of this flour showed the following: an ash of 1.45%, pH on flour extract 6.483, with added acid pH of 6.094; buffer value 3.89; ratio of soluble to total protein 11%; ratio of gliadin to total protein 44%. The original viscosity of this flour showed 50 seconds and it showed no swelling until the solution was made up to .08 normal acid.

We made several attempts to bake this flour, all without success. The correct hydrogen ion concentration could be attained; in fact, the dough was fermented until it was sour and the acidity high. Upon washing gluten from the fermented dough we found it to be practically unchanged. We then soaked this gluten for several minutes in N/10 lactic acid and no change whatever was brought about. Other flours fermented to pH 5.2 show a very silky elastic gluten when washed out, and at about pH 4.5 one can wash gluten from the dough with the utmost difficulty and then only a very small amount. From our experience with this flour we can only conclude that it is so heavily buffered that the gluten cannot be broken down by ordinary means of fermentation. That acid is formed in the dough is certain, but the gluten seemingly is entirely protected from its action.

Before concluding we would like to describe the manner in which we determine the hydrogen ion concentration and the viscosity.

For the hydrogen ion determination we take 10 grams of dry flour and shake for 30 minutes with 100 cc of distilled water, let stand for 30 minutes, centrifuge and filter. The hydrogen ion concentration is then determined on the clear filtrate electrometrically. A few drops of neutral toluol may be added to the water used for this work to provent bacterial action.

For the viscosity determination we take 25 grams of flour (dry basis) and make into an absolutely smooth suspension with 100 cc of distilled water. The flour stands in suspension 30 minutes to allow time for swelling. It is then warmed on a water bath to 100°F and placed in the Saybolt Standard Universal Viscosimeter. All surplus suspension is removed with a pipettee to a constant starting head, corks removed and stop watch started simultaneously. The time is taken to fill a 60cc receiving flask to the mark. This time for distilled water at 100°F is 27.4 seconds.

CONCLUSIONS.

From these experiments and our experience we sum up as follows:

1. The term strong and weak flour as used today is very much overworked as oftentimes a flour is referred to as "weak" when as a matter of fact, the user of the flour is merely giving it more fermentation than the flour requires. Many flours are referred to as gluten bound, when as a matter of fact, they are not given enough fermentation. For the latter class of flours we of course realize that increased amounts of sugar and yeast will offset increased fermentation and it is oftentimes advisable to work them that way.
2. That a test baking made with a fixed and irrevocable baking formula and fermentation period is absolutely no criterion as to the value of a flour. Many flours have been condemned by testing bakers merely because their fermentation period was not that used in some particular laboratory. A fixed fermentation period and formula may be used in a mill laboratory, as the resultant loaves be they good or bad will tell whether or not the flour is running uniform.
3. That there are flours which have so little protection against the softening action of acids that the gluten is disintegrated before sufficient gas can be generated to raise the dough mass.
4. That some flours are so heavily buffered that the time of fermentation required to condition the gluten is too long for ordinary baking practice.
5. That the data submitted in our table gives to one familiar with the chemistry of cereals and the art of baking valuable information to the fermentation period.
6. That hydrogen ion determinations and viscosity determinations may be made upon small pieces of the fermenting dough and thus used as a control of fermentation.
7. That the hydrogen ion concentration alone is not always the true indication as to when a dough is properly fermented; a certain pH usually indicates a certain viscosity, but that the desired viscosity may be brought about by other means is entirely possible. In fact we have found that certain protoletic enzymes used in the dough batch will condition the gluten long before the optimum pH is reached. There is on the market also two preparations of mineral salts, which, when introduced into the dough batch, have a decided effect on the viscosity of the dough. One of these does not effect the hydrogen ion concentration; the other actually decreases it.
8. That gluten quality is affected by the electrolytes present and this quality is largely determined during fermentation.
9. That this paper is contributed not with the idea that it will solve all the problems that bakers, millers and their chemists are heir to, but rather to stimulate interest in the whole problem.

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(1) Technology of Bread Making II, 431—*Jago.*
(2) Studies on Wheat Flour.—*Jessen-Hansen.* Comptes Rendus Des Travaux Du Laboratories De Carlesburg, Vol. 10, Page 170 (1911).
(3) Contribution to Colloidal Chemistry of Bread I.—*Otswold.* Kolloidal-Zeitschriff Vol. 25 Page 26 (1919).

Contribution to Chemistry of Bread II.
Viscosimetry of Flour.—*Luers and Otswold.*
Kolloid-Zeitschrift Vol. 25, Page 82 (1919).

Colloidal Chemical Studies of Rye and Wheat Gliadin.—*Luers.*
Kolloid-Zeitschrift, Vol. 25, Page 177 (1919).

Contribution to Colloidal Chemistry of Bread V.—*Luers and Otswold.*
Kolloid-Zeitschrift.—Vol. 27, Page 34 (1920).

Larabee Flour Mills Corporation, St. Joseph, Mo.

SUSTAINING MEMBERS

The sustaining members of this organization are milling companies and other organizations which have the interest of the cereal chemist and cereal chemistry at heart and wish to give them financial aid.

To increase the knowledge in cereal chemistry and to establish uniform methods of procedure and control of value to their employer.

Any information in regard to sustaining membership may be obtained from the secretary, Mr. A. A. Jones, The Larabee Flour Mills Corporation, Hutchinson, Kansas.

The sustaining member has all the rights of a member except the vote.

A CORRECTION

"Studies on Wheat Flour"—*H. Jessen-Hansen,* the Journal for January, 1922, bottom of page 17 reads: "The exponent of the hydrogen ions in the real dough by adding the log 6.5 : 44 = 0.83 to ———" should read: log 6.5 : 44 = —1.1694 whereas .83 is log 44 : 6.5.

by Henry D'Andre.

CEREAL CHEMISTRY—THE STEPPING STONE

By H. F. Hemperly.

In using this subject before your Convention, I am doing it in a spirit of helpfulness to the boys who perhaps may have aspirations in a business way whereby the application they have given Cereal Chemistry will be of value to them.

I have often thought of a number of men I have known who have specialized in certain fields of technical work, who are still pounding away

at the same old rock. While other young men, not gifted in any particular way, and who have started in the same business from another end, are now far advanced over the man who had the advantage to begin with. I have seen many instances of this very thing and my thought has been: Why should not a man who has had the advantage of special training be of more value to a business than the office boy who has grown up with no particular training whatever? We must, of course, admit that some of the boys have natural inclination for Cereal Chemistry and particularly for research work along this line and are fully satisfied to remain Cereal Chemists as long as they live; for those men they have found their happy hunting ground, but in Cereal Chemistry, as in every other specialized line of work there happen to be men who wish to branch out away from the work and use it incidentally to enhance their income. There is no doubt among the young men assembled here today, a number of men who are highly fitted as Cereal Chemists and in addition have the material for making good business men as well. In my time, I have run across Sales Managers for mills and I run across them today, who have no real knowledge of what their product really is, how it can be used, where it can be used, and to what advantage it can be used. It seems to me that a Sales Manager for a mill, having graduated from the lines and ranks of the Cereal Chemist, is in a better position to make the trade realize what his product stands for; to make them know that his flour can be used for certain things and under certain processes; that he is in a better position to draw on his imagination for selling arguments, than the Sales Manager who has graduated from the ranks of office boy, stenographer, book-keeper, and traffic man.

We all know that if we were to investigate men behind the sales of flour for a large number of mills, we will find that the majority of them never prepared for the selling of flour and in half of the cases their positions were almost wished on them. Now it does look as though the man who has prepared himself, who has the college training and who has mind enough to absorb intricacies of chemistry and its allied subjects, certainly has the mind to apply himself in a business way, in the selling way and in a mixing way just as well as the man who has come up from the ranks before mentioned. Not only in the selling end is the Cereal Chemist qualified, but if he will improve his time by closely observing the milling game from every angle during his work, digging into all the different departments and finding out how they are run, being alert to the policy of the company, studying why they do certain things, also at the same time asking questions of the Traffic Manager, the Cashier, Bookkeeper and Billing Clerk as well as the various officials of the company, he will open up other fields of advancement for himself in this industry. It has been my experience that everybody in the business world will limit you to the work you have been doing. That if once you were a Cereal Chemist in the milling game, they think you should be a milling chemist the rest of your life. Of course, not every mill owner will feel this way and I feel sure that none of them will feel this way if the young men in question will not limit themselves.

It is not the intention of this paper to belittle Cereal Chemistry and make it appear that it is a limited field; however, we all like to get the best things that are to be had in life, and while the majority of us like to be above the materiality of this existence, at the same time every intelligent human being is entitled to all of the conveniences, pleasures and every-

thing that will stand for good that money can buy. In the milling game we will find that the men who made the big money are the men who know how to dispose of the products. We also know, while at the beginning the Cereal Chemist will pull down what looks to him as a fairly good salary, that if he will not awaken to the opportunities that stand before him in the business way and at the same time become a Jack-of-all-trades in the milling business when it comes to thinking and acting, that in five to ten years from the beginning, he will have advanced very little in his money-making capacity. I do not think it pays to be a Jack-of-all-trades outside of one particular line of business, but I do believe that it pays to be an investigator and a Jack-of-all-trades when it comes to one particular line of business, and especially so when a man is looking out into life and looking for a future.

Kipling, in the little verse quoted herewith, expresses the thought that I have in mind relative to digging into the milling business by the cereal chemist.

"I keep six honest serving men,
They taught me all I knew,
Their names are what and why and when
And how and where and who."

A few days ago I happened to run into one of the big men in the selling and disposing of flour and mill products, and he remarked "that he observed that I was on the program of the Cereal Chemists and that the subject certainly covered a lot of ground and a multitude of sins, but for goodness sake, "Hemperly, don't paint things so nice to those cereal chemists, as there are too many brokers and jobbers in the flour business right now." There is not a doubt in my mind that this gentleman's statement is correct to a certain degree, but we must all admit that there is always room at the top, and nothing would please me more than to see more cereal chemists take up this line of work, if they have the inclination to do so, and while they may not wax fat to begin with, still there is always room for the best, and good pay for the men who know their business.

My own personal experience has been that my study of Cereal Chemistry as applied to both milling and baking has been of untold help to me in a business way. It has helped me to put over sales, which would not have been put over otherwise; it has helped me to earn better money than I otherwise could have earned, and while I have not been in the flour business long enough to be called a success, still at the same time I am in touch with buyers of flour and mill products who have faith in my judgment simply because I have been educated in Cereal Chemistry, and know flour; thus Cereal Chemistry has been the stepping stone to my advancement thus far.

Hemperly Flour Co., Kansas City, Missouri.

MOLDS AND BACTERIA IN CEREAL PRODUCTS

By E. Lee Treece.

Plants may be conveniently divided into two great classes, those which contain chlorophyl and those that do not. The fungi are placed in this latter group. Fungi may be described as plants containing no chlorophyl and with but few exceptions making use of spores as a means of reproduction. The bodies of many forms consist of a net-work of threads of hyphae

called the mycelium. From these threads outgrowths occur, upon which the fruiting bodies or spores are formed. These hyphae may be microscopical in size or may extend upward several centimeters.

The characteristics of the spores and their attachment or relation to the hyphae are fuudamental in the classification of the fungi. The word mold is a term rather loosely applied to certain forms of fungi. The one characteristic they seem to have in common is that they are almost ubiquitous in their distribution, being found in nearly every situation where there is sufficient moisture for their growth. They are of interest in the cereal industries as they are found in great numbers in stored flour and meal, where they are able to cause spoilage under certain conditions. Much of the work in this connection has been done by Dr. Charles Thom, Mycologist for the Microbiological Laboratory of the Bureau of Chemistry. He finds the predominating type of mold in stored corn meal to be Aspergillus, finding the Mucors and Penicillium less frequently. He found them in numbers ranging from 1000 to 400,000 per gram in commercial corn meal.

These molds all produce a tangled net-work of hyphae or mycelial threads on the surface and in the substance of the meal or flour upon which they are growing, in this way forming cakes or balls in the product. The molds are essentially saprophytic in nature, depending for their food material upon the carbohydrates and proteins produced by higher plants or animals. These substances are often times too complex to be used without first being split into simpler compounds. This the molds accomplish by means of enzymes, extracellular in nature which diffuse out from the cell walls into the substratum upon which they are growing. LaFar credits the molds with the ability to produce nearly every type of enzyme known. One type of mold may produce a great variety of extracellular enzymes thus being able to split up starches, cellulose, and other polysaccharides into simple compounds which may be absorbed by the cell. Here the absorbed substance is further broken down by intra-cellular enzymes, and part of the molecule used by the cell and the waste products excreted. The waste product usually taking the form of organic acids. Thus when molds are growing in meal or flour the probability of a change in the chemical composition of the product is apparent. This change may be the result of absorption of the waste products of cell metabolism or from the action of the extra cellular enzymes of the mold.

It is known that the carbohydrate content of flour may be reduced materially in a short time by molds if conditions are optimum for their growth.

The growth of molds in flour or meal is dependent upon certain conditions, mainly moisture content and temperature. The moisture content at which molds will grow to any extent in flour and meal is about 13%. *Aspergillus repens* is capable of causing spoilage with the formation of cakes in flour having a moisture content of from 13% to 15%, providing the temperature conditions are satisfactory for its growth. Several other forms are found in meal having a moisture content above 15%. The effect of temperature is largely that of retarding or increasing the rate of growth. Thus a flour with a high moisture content and kept at a low temperature, 10°C for instance, would probably spoil slower than a flour having a moisture content near the critical point and kept at 20°-30° C.

Most molds prefer a slightly acid medium for growth. And many are able to utilize organic acids for their food requirements.

The acids produced by most forms are considered to be an intermediary product of their metabolism, and if left in contact with the organism after its formation will ultimately be used for nutrition.

The familiar bread molds forming on loaves of bread which contain a high moisture content or kept in damp places are usually forms of Mucor.

These may be avoided by keeping the moisture content low, and they may also be avoided by wrapping.

Another group of organisms associated with spoilage of stored flours and meal and also associated with the so-called diseases of bread, is that of the bacteria.

Bacteria are classified with the fungi as they contain no chlorophyl. They are unicellular, although some forms characteristically appear in groups or in chains. They are much smaller than the molds ranging in size from 0.5 micron to the larger forms, 30-40 microns in length.

They may be classified according to their morphology into several groups: thus we have the cocci or spherical forms, the bacilli or cylindrical, rod-like forms, etc. Bacteria are called schizomycetes or fission-fungi because of their method of reproduction. The Bacterial cell, when it reaches maturity, reproduces by simple fission or splitting in two, thus forming two daughter cells from the mother cell. Under optimum conditions this may occur every twenty or thirty minutes.

Like the molds, Bacteria obtain their nutrition from the carbohydrates, proteins, and fats stored up by the higher plants and animals. The action of the Bacterial enzymes are very similar to that of the molds, although fewer species are able to break down the more complex carbohydrates.

The Bacteria usually found in flour and meal may be placed in the following groups: Micrococci, Lacto-bacilli, Colon-Aerogenes, and Aerobic Spore producing.

The micrococci found in flour and meal constitute a large group of organisms which seem to be of little significance in the spoilage of the product. They are rather resistant to desiccation and persist after many other non spore producing forms have died out.

The Lacto-bacilli as a group are probably of minor importance in this connection. These organisms are capable of producing lactic acid from carbohydrates and are similar to the organisms found in dill pickles and silage.

The representatives of the Colon-aerogenes group are important factors in the souring of cereal products. The cultural characteristics of organisms of this group isolated from meal indicate the probability of their being either *Bact. Aerogenes* or *B. Cloacae.* These organisms are rather widely distributed in nature, being found commonly on grains, in soil, in water, milk, etc. The opportunity for their presence in flour is therefore evident. These organisms produce a great variety of extra-cellular enzymes, being able to split many of the more complex carbohydrates and proteins. They are considered as being very active in fermentation, their waste products being in most cases organic acids and gases. They are not very resistant to adverse conditions and rapidly die out during storage of six or eight weeks if conditions are not favorable. Here again the moisture content and temperature are of great importance, there being little or no multiplication of this group in a product containing less than 13% mois-

ture. The organisms multiply rapidly at a temperature of 20°C to 37°C, but at 10°CC development is very slow.

The group of Aerobic Spore producers show very different characteristics,—they are relatively inactive in the fermentation of the carbohydrates in comparison to the Colon-aerogenes group, but produce a variety of proteolytic enzymes. They are also very resistant to adverse conditions. This is accomplished by means of spore production. Under certain conditions the nuclear material is concentrated at one point in the cell and a hard impervious wall is laid down around it, forming the spore. Unlike the mold spores which are produced for the purpose of multiplication, the bacterial spore is for the purpose of tiding the species over some unfavorable condition. This spore is capable of resisting desiccation for many months and will resist boiling for several hours, requiring a temperature of 120° C under fifteen pounds of pressure for five to fifteen minutes to kill. It will withstand a much higher temperature, for a longer time in a dry oven, such as a baking oven. Because of the presence of these spores members of this group will withstand the conditions found in storage which will destroy less resistant forms, and will be found in flour or meal in great numbers when it is used.

An Aerobic spore producer of the Mesentericus group, called *B. panis Viscosus*, has been described as a casual factor in "Ropy Bread".

The organism forms an abundant growth on agar, which when lifted with a needle forms a long hair-like thread. When inoculated into a sterile loaf of bread and incubated for several days at room temperature the bread first seems to become more moist, then of a sticky nature and when crumbs are pulled apart, threads of the viscid material may be seen hanging between them. The culture is nearly always found at the center of the loaf, where the temperature is less than at the outside and is insufficient to destroy its spores. The organism has been found in bakery dust, on the exterior of whole grain and is usually present in flour of good quality, as well as poor.

While present in flour its numbers there seem to be insufficient normally to produce ropy bread, additional contamnation usually being necessary. This sometimes occurs in the bakery through unsanitary conditions, although the disease has been found in clean bakeries. Other members of this group are sometimes found in the center of loaves, causing discoloration, disagreeable odors, etc., but which do not produce the ropy, sticky conditions found in ropy bread.

In summing up, we may say that spoilage of stored cereal products may be caused by the growth of molds or bacteria or a combination of the two when the moisture content and temperature are suitable for their growth.

Since the source of contamination of cereal products with molds and bacteria may be the whole grain, the organisms persisting throughout the process of manufacture, their presence in the finished product is almost unavoidable. Spoilage may be prevented by creating conditions unfavorable for the growth of these organisms, that is, by keeping the moisture content below 13% and the temperature below 10-15° C.

University of Kansas, Lawrence, Kansas.

ASH

By Samuel J. Lawellin

The determination of ash in flour was one of the first chemical determinations to be made use of by the miller. Even today the importance of this test is readily acknowledged in all mills of sufficient capacity to maintain a laboratory. As the determination of ash is more important to the miller than any one else concerned we will deal with the determination of ash in the laboratory and its value and use by the miller. The use of ash values of flour by the baker and salesman will be touched upon lightly but merely to express our personal opinion and not as a matter of argument.

Taking up the determination of ash in the laboratary we will first consider equipment and methods. For the actual burning an electric muffle is generally used. Many kinds are quite satisfactory but they should be of rugged construction and durable. In size they should be large enough so that only about one-half of the sole will be covered by the crucibles of an ordinary day's run. An electric muffle will generally give better and faster results when handling about fifty per cent capacity. Gas fired muffles may be used and, if handled properly, will give equally as good results. In a daily comparison, lasting several weeks, between an electric muffle and a gas fired muffle, satisfactory duplicate checks were secured throughout the entire trial. All tests were handled personally and burning conducted in uniform manner. The time on the different ovens varied and was about three hours for the gas oven and five for the electric. The main reason for the greater use of the electric oven is that it is much easier of regulation and the burning of samples from day to day will be much more uniform.

In the way of analytical balances only the best should be used. Balances should be tested every day for correctness of zero point. Occasionally they should be tested for sensitiveness and kept in excellent working condition. It is needless to say that weighings should be made accurately and it is just as essential that they be made rapidly. When two balances are of equal accuracy the one allowing of more rapidity is always the better balance. From two to five grams of material are weighed directly into porcelain crucibles. If weighings are not made rapidly the loss of moisture during weighing may be enough to cause some error and when duplicates are run this error may be considerable. All ash determinations should be made in duplicate and a sample for moisture determination weighed up at as near the same time as possible. Ash determinations should never be run without moisture also being determined. In ash work, as well as all analytical work, the room should be as free as possible from dust and drafts.

In placing crucibles in muffle they may be placed quite close together but should not touch. Considerable difference of opinion exists as to proper temperature of muffle during burning. Where no pyrometer is used, the generally accepted standard temperature for burning is when muffle is at dull cherry red. Personally we prefer that ash samples be in muffle some two hours before this temperature is reached. Too much emphasis cannot be placed on the advisability of using a pyrometer with the muffle. The pyrometer with automatic regulation allows of a constant temperature and eliminates all guess work and differences of opinion as to just what

"dull cherry red" means. With a pyrometer it requires only a few trials to determine the best temperature and time for your ash and muffle, and then these standards can easily be maintained without any guesswork and in spite of current fluctuations and other influences.

Coming to the subject of Methods of Analysis we strike deep water. It is not for us to say personally which is the best method. This can only be told by many experiments. After many years of work and experiment the American Association of Cereal Chemists have accepted a Standard Method to be used by members. As the majority of these members are in flour mills the method adopted has been found to be the best for this purpose. The recent action of the Kansas Millers' Club, in backing and assisting their chemists in the matter of Standard Methods is certainly to be commended. The fight for Standard Methods was taken up by the A. A. C. C. some seven years ago and still is being carried on vigorously. The Standard or Approved Method for Ash, as adopted by the A. A. C. C. is as follows: "Weigh from 3 to 5 grams of sample into tared crucible and ignite in muffle furnace at low red heat until the ash becomes white or gray-white and free from carbon. Avoid fusing the ash. Cool in a dessicator and weigh. Calculate to per cent ash."

This method is designed to meet the exact conditions and requirements of flouring mills and cereal laboratories exclusively and does not cover the entire field to which the ash test may be put."

The Association of Official Agricultural Chemists have adopted an Official Method for Ash as follows: "Char a quantity of the substance, representing about two grams of the dry material, and burn until free from carbon at a low heat, not to exceed dull redness. If a carbon-free ash cannot be obtained in this minnar, exhaust the charred mass with hot water, collect the insoluble residue on a filter, burn until the ash is white or nearly so, and then add the filtrate to the ash and evaporate to dryness. Heat to low redness till the ash is white or grayish white, and weigh."

Though it can be seen at a glance that this is quite a general method and applicable to many substances, yet it is listed under "General Methods, Foods & Feeding Stuffs." The title in itself is quite comprehensive. This same method is applied directly to the determination of ash in beer, canned vegetables, coffees, distilled liquors, flavoring extracts, foods and feeding stuffs, fruits and fruit products, meat and meat products, prepared mustard, spices and other condiments, teas, vinegars, wheat flour, and wines. It is readily seen that the method is intended to cover a multitude of ash tests and is no doubt suitable for the purposes set forth. However, the A. A. C. C. has endeavored to make their Approved Method for Ash, as well as all Approved Methods, a short concise method to be used only on cereals and especially in flouring mill laboratories.

No mention is made by either organization, of the so-called calcium acetate method for ash. In fact it is quite generally conceded by both Associations that the arguments in favor of the calcium acetate method are quite futile and that the method itself is of no value in the determination of ash of the common cereals. And still many chemists in flour mill laboratories and commercial laboratories, especially in the Northwest, use this method and have the nerve to insist that it is the only reliable method. We say "nerve" as that is what it would take to insist on this method when

the researches of organized associations have shown the method to be antiquated.

Regardless of what method is used it is needless to say that if the same method and same conditions were used by all chemists many of the discrepancies in ash results would disappear. It has been the aim of the A. A. C. C. to get all of its members to use the same Standards and Approved Methods in all regular analyses of their products. And we will venture so say that 99% of the members of the A. A. C. C. use its Approved Methods and that where they do not it is through the interferences of the miller.

The method to use, of course, should be the best method; but one of the main things is to get all the chemists in mills to use the same methods and under like conditions. Were it left alone to the chemists this would be easy but to make this plan effective we needs must have the co-operation of the millers. The chemists can formulate the best method and best conditions but it is up to the miller to provide the apparatus to get standard conditions and to permit standard methods to be used. Electric muffle furnaces are quite common in mill laboratories, but without a pyrometer or high temperature thermometer these furnaces cannot be controlled at the same standard temperature. The low price and advantages to be gained from the use of a pyrometer make it ridiculous for any mill laboratory to be without this necessary aid to proper ash tests. If the miller will provide the necessary apparatus and give his assent to the using of Standard and Approved Methods the chemist will gladly use them and the outcome will be better results, less discrepancy in comparisons, more value and satisfaction to both the miller and chemist.

The value of the ash test to the miller is in checking the operation of his mill from day to day. Ash uniformity is one of the essentials of a uniform flour and is also useful in judging good clean milling. Trouble in the mill will quickly and surely be shown in variation of the uniformity of daily ash tests. Every change in the mill or milling mixture is likely to be shown in the percentage of ash. Of all these the miller must take cognizance and from the observations in his mill should be able to quickly locate any trouble or variation in any of his machines and especially his rolls. A little experimenting on his system will soon show the miller what changes will quickest show up in the ash determinations. He should know what effect the fineness of his breaks and reductions would have on his ash and be able to make deductions accordingly. Even the corrugations on his rolls have a certain influence. In the operation of his bolters, sifters, reels and purifiers the miller can greatly influence his ash. The kind and size of clothing he uses are of material importance. The point of suction, as also the amount, in his dust collecting system should be studied by the miller for its influences on the ash of his products. The ash and color together will show him quicker and more satisfactorily than any thing else the non-functioning of these vital points in his system. He should be able to forecast the effect on his ash by any change in his wheat mix or milling system. The miller should also be able to take the chemist's result for ash and know where to look for trouble if any has been indicated.

We do not believe that many millers use the percentage of ash as an argument for the quality of their flour. Our experience has been that they

use it more as an argument that they are turning out uniform flour and the specific grade called for on any contract. Some may argue that their low ash content is a mark of the quality of their flour but they are the exception and it is a serious mistake. However, many millers do use, and are justified in using, the percentage of ash as an argument that they are doing quality milling, honest milling, and giving the customer the kind of flour for which he contracted. For the miller to talk flour quality from the ash per cent alone is quite absurd. As far as a sales argument by the miller or as an argument by the salesman there are only two uses for an ash determination—grade or percentage of flour, and uniformity. The miller's great use for ash determinations are for his own information in the control of the mill and here it becomes of great importance. If the miller will do a little experimenting there is no limit to the use to which he can put the ash determination.

The baker is the one who gets the least value from, and makes the most fuss over, an ash determination. It would seem that they have some idea that the percentage of ash has some direct relation to the quality of the flour. Just what this relationship is would be hard to say. It is certain that there is no definite connection between the per cent of ash and the quality of flour. It is quite true that with wheat of the same kind and class a flour of a certain percentage will somewhat tend to vary in quality as the ash varies. To what extent this can be carried has never been determined, but it is believed to be within very narrow limits and to be not alone caused by ash. Naturally, in buying his flour, the baker should know the ash content and should use it as an indication of grade only. The per cent of ash would show no appreciable effect on the quality of the flour or the bread baked therefrom. Knowing the ash content of the flour he specified, the baker has every reason to expect flour that will not vary over 0.02% from that figure, always taking into consideration the difference in moisture content. If he is afraid the miller will ship him a cheaper flour he certainly has the privilege of having his flour analyzed to see if he is getting the grade he purchased. But does he take into account the lowered moisture content occasioned by transportation and storage? If not he is doing the mill an injustice. To condemn a flour on the per cent of ash alone is an injustice to any flour. The baker should not buy flour on ash content alone nor should he specify a certain percentage of ash.

Summing it all up we would say that the miller's main use of ash is in the operation and control of his mill, to assist in making his mill mix, and as an indication of the quality and uniformity of his milling. He is undoubtedly the one who gets the most value out of the ash determination.

The baker makes use of the percentage of ash as an indication of the grade of the flour. He may also us it to check flour shipments and see that he is getting the grade he purchased. To purchase the flour on ash content alone is certainly a poor business system.

The ash test is of importance, but not in determining flour quality or value. Its greatest importance, outside of mill control, is when supplemented by a complete chemical analysis, and to fail to make allowance for variation of conditions of determining ash and variations of moisture content is to fail to be fair.

The Eagle Roller Mills, New Ulm, Minnesota.

THE RELATION OF MILLERS AND CHEMISTS

Address of Newton C. Evans, Editor of NATIONAL MILLER

(Before the American Association of Cereal Chemists, June 6th, 1922)

When your president asked me to talk upon "The Relations of Millers and Chemists," I encountered a real problem. It was not the probable attitude of millers themselves, because sentiment has veered around a great deal within the last few years. Five years ago I should have been condemned and anathematized for venturing to address you. Today, such a move is greeted with approval.

Now the real problem confronting me was whether to make this speech a series of editorial reminiscences or give you the present-day opinions of millers themselves.

I could probably talk to you for an hour or more of instances of good and bad relationship of millers and chemists—cases that have come under my observation. Letters pour in upon any editor who enjoys the confidence of his readers.

Only a small portion of these are for publication. The remainder are for his own consumption—telling him about certain conditions and asking his personal advice and views.

From such letters and frequent visits of millers to his office, the editor gains a rather good working knowledge of many different kinds of milling subjects.

You may regard it as unfortunate that in the question of millers and chemists I have been able to get first hand only the millers' viewpoint.

To offset this let me state that I've always been a firm believer in cereal chemistry—so that millers, when relating their atrocities of chemists have found me a sympathetic but not a credulous listener.

I am not here to make apologies for the miller or to plead his cause with you.

I am proud to be the editor of a milling journal.

I am happy to have the friendship of the majority of flour millers. You can well realize that I would not willingly lose their friendship. It is as the mouthpiece of the millers of the United States that I am talking to you today. My earnest hope is that you will come to understand and appreciate them better.

I don't mean by this the head miller in your own plant, for your lines may not be cast in altogether pleasant places—but the miller in the aggregate. The miller who has dragged himself up to his present minence by the hardest kind of work, close application, pure grit and natural brains and who remains in spite of all the most human, kindly and lovable soul with whom I have ever come in contact.

After careful deliberation, I decided that you would find up-to-the-minute views of millers much more interesting and valuable than anything I could extract from the storehouse of personal experience.

So, about three weeks ago, I sent out a questionnaire to 300 superintendents and head millers. The list was selected with great care, taking in only mills which had laboratories of their own or which used commercial laboratories. All section of the country were included as well as all sizes of mills. The result, therefore, I believe to be a quite accurate census of

the milling industry, at least that part of it which has had some experience with cereal chemistry.

The questions I submitted to the millers were as follows:

1. How much reliance do you place in cereal chemistry?
2. What are your own relations with the chemist?
3. Do you carry problems to him for solution?
4. Does your chemist do only routine work?
5. What lines of research work do you suggest?
6. How may your chemist be of more service?
7. Do you believe the chemist should work under the superintendent or the manager, and why?
8. How may friction with chemist be avoided?
9. Do you favor chemists learning milling?
10. Should millers know more about cereal chemistry?

Some of these questions may appear irrelevant to you but a little consideration will show that they are not—that they are designed as links with which to construct a chain of solid facts.

Nearly all of the millers replied to the questionnaire. As I left Chicago to come to the convention the answers were yet coming in. I believe that the total replies will reach fully 95 or 96 per cent of the letters mailed out.

This high percentage of returns indicates the widespread interest that millers have in the subject.

By promising not to disclose the names of the millers without their permission, I induced them to write freely and give their real honest-to-goodness convictions.

I wish I could tell you that every reply was favorable—but this is too much to hope for and I know you want me to tell you the exact truth—the unpleasant as well as the pleasant.

For example, one of the first letters received contained the following:

"Now, Mr. Evans, the writer has milled the last 37 years under all kinds of conditions and all kinds of wheat. He has never found where the so-called average chemist has been able to help a miller. All the chemist has ever done is stood between an Office Manager and the Miller and has criticized the output of the mill without offering a remedy. We have worked for years and years to see the miller come into his own, and just about the time we poor millers were beginning to be recognized along comes the chemist and tries to cheat us out of our reward."

This was written by a Kansas miller, a very able man in his line, but one who has probably had unfortunate experiences.

He voices a common complaint, that chemists are prone to criticize without offering suggestions as to the remedy. In other words, he feels that constructive criticism among chemists is badly lacking.

If we regard the result of the questionnaire as a reliable index (and I believe we can) the millers of the country are divided into three groups. Forty-seven per cent place absolute reliance in cereal chemistry; 29 per cent accept the chemist with reservations; 24 per cent are doubtful of his value.

This means that slightly less than one-fourth of the millers are opposed to cereal chemistry. I believe this percentage will be materially low-

ered in the next two years if the chemists maintain their present rate of progress.

I am going to read you a few of the comments on the first question. Lack of time prevents reading them all, so I've selected only the more interesting ones.

"How much reliance do you place in cereal chemistry?"

Says a Kansas miller: "I believe most chemists are reliable and get pretty close together on gluten and loaf volume, but I would not sell or buy on a guarantee of ash for I have known different chemists to vary .13 on the ash on the same flour and have known the same chemist to vary .05 on the same flour sent from the same sack at the same time. I think if the chemist himself had the time to do the work, the determination would be more uniform. I believe the greatest trouble comes from turning over too much of the work to a $50 a month boy."

An Indiana miller says it depends entirely upon who is doing the work. If the chemist is competent, the laboratory is reliable.

"Chemistry has done wonders in the manufacture of flour and the end is not yet in sight," according to a Pennsylvania miller.

One of the best millers in North Carolina writes:

"I believe that Chemistry had a place in every well regulated milling industry, especially in the hard winter and spring wheat sections that cater to the bakers' trade. I do not believe that milling chemistry is a cure for all ills, but I believe that a good chemist can be of a great deal of assistance to the milling Supt., if the two will co-operate."

"The time is coming when it will be necessary to have a chemist in every flour mill," says a Missouri miller.

An Illinois miller goes to some length in answering the question as follows: "While milling chemistry may be said to be still in an embryonic state, yet it has been of benefit to the trade. Its future benefits, and I might say its existence, will depend largely upon the chemist himself in what he can bring to the trade by vision, initiative, application and education. He must be able to visualize the unknown elements of the grain structure and place each element in relative value to the whole, or to the loaf value. Initiative and application should be crowned by nothing less than a University education to sustain his findings. Routine work is superficial and can be best done by the public chemist. But the grand question as to the real present day value of the chemist rests upon this. Does the milling company employing a large corps of chemists turn out a higher class product than the milling company of equal capacity employing none. I have in mind a milling company I visited some time ago employing high-class chemists, using first-class equipment and in course of general conversation turned to flour values, comparing same with another mill of slightly larger capacity but using no chemists. The first milling company which I shall designate "A", made a medium patent, while Company "B" made a very long patent flour. They frankly said that "B" Company received from 80 to 90 cents more per barrel than they did. It might be stated that the "A" Company did not know the length of the "B" Company patent. Both mills bought their supplies, hard winter wheat, and sold their product in the same markets. This comparison of the product of two equally situated milling companies shows that their fine laboratory equipment and corps of first-class chemists were of no practical benefit to "A" company. I do believe there are many milling companies using occa-

sionally the Public Chemist making a higher grade output in detail than those having chemists. Until the milling company using a private chemist can show a much superior product in detail than the non-users, the value of the mill chemists will be questioned."

A New York miller says: "I place enough reliance in chemistry, that I would not try to operate a mill, or compete with other mills, unless I had a laboratory, and a chemist in charge whom I had checked enough to feel confident that he was accurate in his determinations."

Another miller from same state holds this view: "I believe, without the aid of a competent chemist, the miller is at all times working somewhat in the dark. The laboratory is the direct way of a miller checking himself as to the results produced from day to day. We have had an up-to-date laboratory here for the past four years, and it would make me feel somewhat at sea not to get daily checkings of the day's run."

A Missouri miller injects a new point into the discussion: "I consider the chemical analysis of wheat and flour of little importance except in connection with physical analysis. That is, chemistry cannot tell us all we want to know about wheat and flour, but the things that it can tell us are of tremendous importance."

It depends much upon who is the chemist evidently for a Kansas miller tells us: "I have implicit confidence in our present chemist's ability, therefore, place the utmost reliance in his determinations; but I will be frank to say that we have had chemists on the job that could not guess any better than I can. Personally I am willing to give the chemist all the credit he is entitled to and will admit that I can do a better and more uniform job of milling with the assistance of a good chemist than I can by depending on my own resources, but in my experience I have had to work with chemists that were about as much of an adjunct to the milling business as a wart on an old maid's nose is to her beauty."

"From my own experience," writes an Iowa miller, "I am satisfied that chemists can furnish a great amount of information as to the bread-making qualities of certain kinds of wheat before grinding, thus avoiding complaints from the baker or housewife, which might not only be expensive but also mean the loss of customers."

A Texas miller says: "With the chemist, the miller can settle questions to his own satisfaction, while without the chemist, these questions would always be in doubt."

"I depend a great deal on my chemist," writes a Kansas miller, "but if his report looks at all doubtful I have it duplicated."

A Minnesota miller says: "Chemists make errors because they are human and also because there must be some allowable errors or variation, perfection being a relative thing in nature except in the abstract. I place so much reliance in cereal chemistry that I would not care to be without it in my mill. It is of little use to know your mistakes after they are made, hence, cereal chemistry must be used on raw materials to determine the blend and on the finished product for checking purposes."

From a Texas miller: "It is well to know just what we are doing. The housewife does not care anything about ash, acidity, carbohydrates, etc. All she wants is flour that will rise and stay that way. Also color. They all want white flour, regardless of its other qualities. But it is different

with bakers. They want chemical analysis. I think they got this habit from the millers themselves."

From a Montana miller: "I place 100 per cent reliance in chemistry, if the chemist or any other efficient person is performing these duties carefully and accurately, but if said person is not accurate, the equipment and analysis are absolutely worthless and if anything, they are detrimental to the milling interests in general."

From a Kansas miller: "A good chemist is as necessary for a miller as the milling journals. Many a solution is worked out by the miller with the aid of the chemist. If you have a hard working chemist that attends to business all the time he is worth hanging on to."

From a Texas miller: "I rely upon chemical analysis of our products as a check upon my judgment gained from practical experience, and find that it is a very great help in the elimination of the guessing factor."

Here is a rare example of tolerance from a Nebraska miller: "Our chemist at the present time is a boy just out of school. Sometimes his results are a little wild, but he is absolutely honest and we hope that with a little experience he will make a real chemist. I would not want to take any one's chemist report as the absolute truth. On the other hand, I would not care to run a mill without some kind of laboratory service."

The above is echoed by a Washington miller who states: "I place a good deal of reliance in chemistry as a whole, or average, but not too much on one report."

From a Missouri miller: "I depend on the chemist to give me the correct analysis on everything that goes to him. If it does not seem right we talk it over and try to arrive at a proper understanding concerning the matter. If he has any doubt about correctness, he makes a check on his work again, and we try to get to a common understanding. We work in harmony with each other, and I always ask his opinion on everything that comes in his line."

The opponents of cereal chemistry almost without exception, take as the text for their letters the variance of chemists' reports. I will cite only one example which came from a Kansas miller who says: "I have never yet found two chemists that would agree on a sample of flour. I don't think much of the average flour chemist. A flour may show up very poor according to the so-called chemists's report, and still come out of the oven a very good palatable loaf of bread."

The whole question is remarkably well summarized by a Western miller who says: "I try out any of my chemist's suggestions unless I positively know the suggestion to be contrary to the principles of good milling. I expect my chemist to show me the same consideration."

A great many millers link up the second question: "What are your relations with the chemist?" with the first, implying that their reliance and confidence in cereal chemistry is dependent upon their own relations with chemists.

On the other hand, an Oklahoma miller, who expresses himself favorably on cereal chemistry as a whole, admits that the relationship of his chemist and himself is not what it should be.

In this connection it is worth noting that only 52 per cent of the millers report pleasant and congenial relations with their chemists. Compare

this with 76 per cent who have a whole or partial reliance in cereal chemistry and you will see that something is wrong.

Better relations are badly needed in 48 per cent of the mills. How this result is to be attained we will discuss under another heading.

The answers that most impressed me were the ones which indicated mutual helpfulness.

Said a Utah miller: "The chemist and myself are associated together to discuss the problems which come up during the day."

"Cordially co-operative" are the relations between a well known Texas miller and his chemist. I like the phrase exceedingly.

"We respect each other as competent in his own field and work in absolute harmony" is another splendid answer.

A Missouri miller points out that "he has the same access to the laboratory as his chemist has to the mill."

A New York miller says: "We work together at all times and on anything we can think of to improve milling."

A Kansas miller says: "I have never wasted any time quarreling with any chemist that I have ever worked with. When they get arbitrary I simply ignore their orders and do as I please and let them think that I am doing just as they say. I have been in the business long enough to know that when a man thinks he can make an arbitrary ruling to go by in running a mill, that he is ignorant enough so that you can put most anything over on him and he will never know the difference."

The answers to Question No. 3.—*Do you carry problems to the chemist for solution?*—bear out my conviction that millers do not use all the resources available to them.

The bulk of the millers seem to regard the chemist as having very well defined duties with what it is poor policy to interfere.

However, there are a few exceptions.

For example, our friend Edgar Miller of Leavenworth, Kansas, tells me: "I rely on our chemist for information relative to the chemistry of wheat and flour and collaborate with him in all milling problems."

B. C. Williams, of Wichita, chips in with this: "Our chemist is the first person we go to when some trouble comes up, and we always find him ready and willing to help us."

A Minnesota miller writes that he carries the same problems to the chemist that he would determine himself if he had time and division of labor were not the better way.

The Texas millers seem to lead in acknowledging the aptitude of the chemist for solving problems requiring scientific training.

Questions No. 4 and No. 5 might be grouped for purposes of discussion. In the majority of mills, the chemist apparently does routine work with wheat and flour and has little time or opportunity to devote to reresearch work.

However, millers are not slow to suggest the lines of research work they would like chemists to pursue. Among these let me quote:

1. More standardization, both in methods and equipment.

2. Atmospheric conditions and the control of moisture or humidity in the mill.

3. A good tempering system that will not take so long as the present system.

4. Methods of protein determination that will indicate quality, as well as quantity.

5. The best way to mill frosted wheat.

6. Effects of bleaching on all flours.

7. Effects of long and short tempering.

8. Careful research work in connection with wheat as received, building up and maintaining a standard milling mixture.

9. Testing of fuels, lubricating oils and grease and everything else around the mill which will tend to keep down the production cost.

10. Wheat investigations, that is, detemining the best varieties to be grown for milling purposes in different localities.

11. The cause of the increased quantity of oils or fat in the last crop and how to eliminate it.

12. Determine how long a farmer can use seed from the same crop of wheat before it will deteriorate and not produce good flour.

13. The most effective way of destroying mill pests.

14. Shortening the milling system.

15. Methods leading to the production of less specky flour.

16. More information as to germ, placenta and parent stem of wheat.

17. A short method of finding the food value and baking value of a given sample of wheat.

18. Find a way for the small miller to determine quality of gluten when he is some distance away from a laboratory.

19. The relationship between ash and strength of flour. Not always, but frequently a better loaf is obtained with a higher ash percentage, even though low and high ash flour be from same wheat and the percentage is the same.

20. How to get a good color without ageing, chlorine and other present day chemicals or long storage.

21. Effect of tempering on the quality of gluten; that is, what effect does water (cold and hot) heat, wet steam or any other combination of the three, have on the quality of gluten; and what effect does an excess of either have on quality of gluten? Also length of time of tempering before gluten will be weakened at different temperatures.

22. Determining the exact amount of flour in each variety of wheat, so that the chemist can subtract offal and quickly let the miller know whether there is good flour going to the feed bins.

23. Give each of the constituent elements of the grain, especially the flour making portions a factor value, expressed in percentages relative to their value, for or against, in the bread. This arrangement would call for two columns, a positive value column and a negative value column.

24. Work along the line of ascertaining the value of the starch elements of the flour. At present the tendency seems to be to rely wholly upon the protein content of a sample of wheat or flour in determining its quality while the quality of the starch is being ignored. Protein determinations, while an excellent index of food values and a partial index of baking values, are not a reliable guide in blending wheat or in determining the baking

quality of a sample of flour; for, while they give us a line on the gluten quantity, they give absolutely nothing on the quality. Quality of gluten, as is well known, is of greater importance than the quantity. It is the opinion of many millers that the baking quality of a flour depends as much upon the quality of the starch, its convertability into dextrose or sugar, its availability as a yeast food, as it does upon the quality of the gluten.

25. The development of speedier methods without sacrificing accuracy, and some reliable means of quickly detecting any unsoundness in wheat or flour and determining its nature and extent.

The Southwestern miller who sent in this last suggestion says further: "Few mill laboratories have the facilities or the mill chemist the time for very much research along these lines. I believe these things should be worked out in a research laboratory, established and maintained by the milling industry, along with many other things of unrealized importance to the farmer, the miller, and the consumer, that can only be discovered by painstaking study and experiment.

Question No. 6.—"*How may your chemist be of more service?*" can be disposed of very speedily.

Those who are satisfied with their chemists report that there is little more that they can be expected to do.

Several bring in again the discrepancies noted in flour analyses and urge chemists to be more accurate.

One Kansas miller suggests that the chemist can be of more service by working 24 hours ahead of the mill instead of 12 hours after.

A Montana miller thinks the chemist needs an assistant in every fair-sized mill, supposedly a high school graduate or chemistry beginner who could run the more simple tests and allow the higher priced chemist to do more important work.

A Kentucky miller asks for complete analysis of all streams of flour and continued analysis of any streams that are not up to what they should be, co-operating with miller as to bettering any stream until desired results may be obtained.

A Texas miller says: "My own view is that the chemist could be of more service if he didn't put so much reliance in the baking of bread. In the South and Southwest very little bread is baked in the home. I dare say that 75 percent of our own output is made into biscuits. Yet the cereal chemist doesn't take this biscuit making very seriously. Not long ago we had a couple of sacks of flour returned with a complaint. The chemist's report indicated that the flour was O. K. because it made good bread. Yet the customer was supplying a biscuit trade instead of a bread trade.

The next question has been a bone of contention for years, yet the answers show a considerable divergence of opinion.

"*Should the chemist work under the mill superintendent or the manager and why?*"

149 head millers or 52 per cent of those replying believe he should be subject to the authority of the superintendent.

32 head millers or 11 per cent think he should be under the manager only.

104 head millers or 36 per cent say the chemist should have charge of a separate department of the mill, reporting to both the manager and the superintendent.

One, a New York miller, is neutral. He says:

"I don't think it makes any difference which one he works under if he is a chemist who is willing to work for the company's interests. I have operated mills where the chemist was under manager and operated mills where chemist was under me. I had no trouble either way. However, chemist and superintendent must be congenial at all times and work for each other.

The most interesting letters on the superintendent's side were the following:

From a Texas miller: "It is the superintendent's work that the chemist is dealing with. Again, about 99 millers out of 100 do not really know milling, and if they did, would not know the weak points of their mill the way the superintendent does."

From a North Carolina miller: "The chemist should work under the exclusive supervision of the milling superintendent, and not act as a spy between the superintendent and the main office. As the milling superintendent alone is responsible for quality and quantity he should have the supervision of the heads of every department of the operative end of the mill. The writer has found that where one or more departments get their instructions from the main office, there is invariably more or less friction between these departments and the office; and this friction will reflect more or less back to the main office."

From a Kansas miller: "It is my opinion that the chemist should, in most cases, work under the superintendent as much so as one of the second millers. This is because his duties are so closely associated with the manufacture of flour in that his analyses assist the superintendent in producing as nearly as possible a uniform grade of flour at all times and under all conditions. I also recognize the fact that in mills where a great deal of flour is bought for blending purposes it will be necessary for the chemist to make reports to and work under the manager or whoever purchases this flour. There may be also cases in certain plants where they do no blending that the chemist will have to work for both the manager of a plant and the superintendent. And I think this is a fact in most of the small plants that employ a chemist. I do not, however, consider this a good arrangement as it is hard for a man to serve two masters and do justice to both."

From another Kansas miller: "Where there is a laboratory the chemist should be under the superintendent. If not, the superintendent is not capable to run the mill successfully. There is always more or less friction when the superintendent is left out and the so-called chemist works under a mill manager who, in some mills, should be cultivating corn instead of managing a mill."

Putting the chemist under the superintendent to take more interest in the work of the laboratory, in the opinion of a New York miller.

A Minnesota miller says: "Under the superintendent by all means. The chemical laboratory is to the mill what the periscope is to the submarine. The obect of milling is to produce and merchandise flour. The laboratory is auxiliary to the production department, of which the superintendent is the head; it has no connection with any other department nor can it be of any great value to any other department."

From a Missouri miller: "I can see no objection to the chemist being under the direction of the miller; Mr. Lawellin, in his article in your pa-

per, raises the point that the miller is usually a man of moderate education, and therefore should not be in authority over the chemist, who is a highly trained specialist. I will ask, how much more competent is the manager? It seems to me that since the laboratory was first installed to assist the miller in keeping his flour uniform in quality, the miller should be the one to designate what tests were to be made. No miller would be fool enough to attempt to tell the chemist how to make his tests. The whole controversy between the millers and the chemists, when simmered down, amounts to just this: the chemist wants to be a bigger man on the job, than the miller, and the miller quite naturally does not take kindly to that idea."

Says a Texas miller: "If this question were settled I believe sailing would be easy. The superintendent is responsible for the operation of the mill and its output. If anything comes up not right the manager goes to the superintendent. Why not let the superintendent have perfect control?"

Another miller from the same state says if the manager is a practical miller, the chemist should work under him, otherwise, the mill superintendent.

From a Kansas miller: "I find in some cases where the chemist is working under the manager, he assumes the idea that he has got an edge on the superintendent and very often his advice takes on the proportion of orders, which causes friction, while there has never been any friction in our plant between the chemist and millers, I am sure."

From an Illinois miller: "The man, by environment and training, builds up and supervises organization; the man who is responsible for the mill's output in detail should be supreme and in command; therefore, the head miller should be in charge. For obvious reasons the superintendent should welcome and encourage the plan of the management employing the chief chemist, and the chief chemist is best fitted to employ his assistants. Where the superintendent employs the chemists, the management might be prone to fear collusion, a condition that both superintendent and chief chemist should never permit to exist, as it will in due time work to the harm of both. In the case, too, of the miller not being very enthusiastic about milling chemistry, the chemist would not have the freedom of action necessary to be of full value to the company, doing only routine work at best.

"Many phases of harmony and inharmony between superintendent and chemist can be shown, while the chemist should be employed by management, their relationship should practically end there. And if both could only be broad enough mentally to understand conditions and to collaborate in the interests of each other and the company, it is possible for the American Association of Cereal Chemists to instruct its members to be subordinate to and in harmony with the superintendent."

From a Texas miller: "The superintendent is held responsible for the ultimate results and he should have absolute control of the operative end of the business. If the chemist is responsible to the manager it will often create friction. Problems that arise should be discussed between the superintendent and chemist, but as the man who bears the burden, the superintendent should be the man to decide."

From a Nebraska miller: "I believe he should work under superintendent, to enable superintendent to secure better results and co-operation.

He will listen to manager anyway, and to make good his findings must satisfy the manager."

An Arizona miller believes a chemist will always be of more service to his company when working under the superintendent.

A Tennessee miller takes a similar view, arguing that it produces better teamwork when the chemist is under the head miller or superintendent.

A Utah miller says: "The chemist should work under the superintendent because the manager is a very busy man, besides having little knowledge of manufacturing flour."

Says a Montana miller: "I believe the chemist should work under the superintendent on account of the superintendent being held responsible for the manufacturing end of it, as well as the finished product; but if the company has no confidence in the superintendent they should either hire a new superintendent or have the laboratory in the office and samples taken by the office force."

A Kansas miller says: "I do believe the chemist should be under the superintendent for this reason: As a rule the chemist has a form all his own that he works to. So far, fine; but in case of a change in blending or grading certain stocks the superintendent wants a little work of his set form. Then comes the question of too much work and maybe you get it, and maybe you don't; and if he knows it has to be had he will go to work, and there's nothing more said. So if the superintendent is held responsible for the product he ought to be held responsible for the rest of the manufacturing."

Another miller from the same state says: "The chemist should at all times work under the superintendent. My reasons for this statement are: 75 per cent of the mill managers are very unreasonable in their demands. They expect the head miller, in a way, to be infallible, and to produce results with poor equipment; expect him to make a good quality flour from off-grade wheat; limit him in supplies, and do not co-operate with him as they should, placing too much confidence in the chemist's report without taking other matters into consideration. What can a manager do with his mill without a capable miller? I believe with all my heart that the miller in charge should at all times co-operate with the manager, and the manager should in return give full co-operation to his miller."

A Washington miller says that the chemist should work under superintendent, but it is essential that the latter have some knowledge of cereal chemistry.

A Colorado miller says: "Let him work under superintendent, because there is always better work done when *one* man is "Boss". The ordinary superintendent will never hamper his chemist, but will give him all the assistance and encouragment needed to carry on his part of the work, just the same as he would to his grinder or second miller."

Now on the other side of the question, we find a number of good arguments. Many answer locanically "The Manager" without stating their reasons. Others fear collusion with the superintendent, frankly stating that the chemist can make his report to suit expectations.

Here is a good comment from a Missouri miller: "In my opinion, neither the chemist, the head millers, the warehouse formen or the sweepers are working for the superintendent; but with him, and for the management. True, some of these men must look to the superintendent for specific instructions relative to their work, while others do not have to. The chem-

ist is at the head of one of the departments of milling, and I, as a superintendent, am fully convinced that I could replace him at any time I became satisfied that he was incompetent or disloyal. However, I expect and insist that his work be presented directly to the management without passing through my hands. I consider the position of the chemist in the modern flour mill as somewhat analogous to the legal adviser of a corporation. He is consulted by the manager the sales manager and myself, and he must be in a position to give each of us the information asked for. He should know what means to follow to gain this information, and my only interest in his methods is that they give accurate results. I insist that all reports on flour be made directly to the management, as well as to me. I want the chemist to tell me when anything is wrong with the flour, and I welcome suggestions as to a probable remedy. However, I expect to weigh the evidence presented to me, consider the suggestions for what they are worth, and then rely upon my own judgment as to what remedy to apply. The question of "who is boss?" is never discussed in our organization. There is no "boss"; but it is very likely that it is pretty generally understood by all concerned that the superintendent is possessed of considerable authority, which he tries very hard never to abuse."

Says a Texas miller: "This question has never been an issue in this plant. I think it depends on which is the most progressive and best fitted by knowledge and experience to comprehend and appreciate the benefits to be obtained and to judge the value of the work being done and to be done. Our laboratory was installed nine or ten years ago at my request and I selected the first and succeeding chemists after consultation with the manager, and in each case there has never been any friction. On the contrary there has been mutual confidence and the fullest co-operation between manager, chemist and superintendent, and I may add, all the millers and sales department as well."

Another Texas miller holds this view: "I believe the chemist should be under the personal supervision of the milling superintendent as to his routine and research problems, but I think the laboratory should be a department in itself, and a copy of all reports and findings should be submitted to the General Manager, and he should at all times be kept in close touch with the laboratory work as also should the grain buyer, in order that the most advantageous transactions may be made in connection with the purchasing of the wheat to be milled."

A Minnesota miller says: "Not necessarily either the manager or the superintendent. His routine work should be left entirely to the chemist, his honesty and capability. He is not fit to retain his job if he doesn't possess these qualifications. Problems that are common should be discussed by the superintendent and manager and any information needed from Laboratory by them should be forthcoming. It is not a case of any one trying to put anything over the other fellow. That policy only leads to ruin, and any manager or superintendent or chemist trying to apply underhanded methods is not worthy the name. Co-operation is an endeavor to learn the facts this year and always. Why pay out lots of money to fool ourselves? My idea is that the manager has his duties, the superintendent his, the cereal chemist his. All upstanding, honorable, free men. At certain points their duties come into contact and even overlap. Where they overlap it is not a question of who is big "I", but right here is where

common sense and co-operation make for clean, clear decisions."

Says a Kansas miller: "If a chemist is a real honest-to-goodness chemist I don't think that it is necessary for him to be under either the superintendent or the manager so far as his work is concerned; if he is really interested in his work, and in any way conscientious about his work he will do it without a boss, no difference whether it is research work for the superintendent or running a protein determination on a sample of wheat for the manager or wheat buyer or a crude fiber determination for the feed salesman. The main thing is to get him to understand that he is only one of the cogs in the big wheel the same as the manager and superintendent, and not the whole wheel.

A Minnesota miller writes: "The words 'superintendent' and 'manager' cover quite a variety of duties as you run into it in various milling plants throughout the country, so let me say that the chemist should work as an individual department but should be in perfect harmony with the man who supervises the total operation of the plant."

A Missouri miller (one right here in Kansas City, by the way) says: "The chemist should be head of the laboratory, the superintendent should be head of the operation of the plant, the manager should be chairman of the board at all times, as he is the man who has to make the books balance at the close of the year on the right side."

An Indiana miller think that with the chemist under the manager, the latter will be kept in more direct touch with the operating end of the business.

Another Indiana miller favors a division of supervision. "The chemist," says he, "should work under the manager in buying wheat and under the superintendent in testing of flour and working out mill problems."

A Kansas miller believes that the laboratory, properly handled, should be the main consideration. He says: "The chemist should be left free and unhampered to get results for the plant, regardless of the glory of himself, the manager, the sales manager or the head miller."

Another Kansas miller agrees that the chemist should work under his own ideas. "Telling him how to do his work," he opines, "would be like trying to teach the teacher."

One miller (he too, is located in Kansas) submitted the questionnaire to both the manager and sales manager of his mill and returned three to us, completely filled out. It is interesting to record that the superintendent believed in a separate department for the chemist, the manager believed he should work in conjunction with the superintendent and himself, and the sales manager thought he should work entirely under the superintendent.

Question No. 8. "How may friction with the chemist be avoided?"

Fully half of the millers concur in the belief that if the chemist is subordinate to the superintendent there will be no friction.

Other views are short and concise. For example: "Play the game square"; "Let each use good judgment"; "Be broad-minded"; "Do not let petty ideas or thoughts enter the case"; "By being friends with each other"; "Let them each lay their cards on the table and if they're the right sort they can easily adjust their differences"; "By co-operation at all times;" "By both being willing to learn;" "By not being too sure of anything;" "By mutual helpfulness;" "Let the chemist be just in his dealings with himself and the head miller;" "By holding the chemist re-

sponsible for correct results;" "Using good common sense;" "Work hand in hand;" "Pull together;" "Let both sides be willing to make concessions:" "Let them both try to be gentlemen;" "By chemists being more careful in testing;" "Both sides must exercise a spirit of fairness."

Several millers declare there should be no friction, but if there is, the one causing the trouble should be fired, whether head miller or chemist, in the interests of harmony.

A Nebraska miller thinks that chemists are not always so tactful as they might be. Says he: "The millers are usually much older men than the chemists and the latter should use diplomacy in dealing with them."

A Texas miller reports: "Nine times out of ten the chemists are college graduates and think that because the miller doesn't have the education, he doesn't know as much as they do. However, if friction is to be avoided, they must realize that the miller has gone through the hard school of experience."

A Michigan miller says: "If the chemist makes any suggestions, the miller should not ignore them but give them consideration. On the other hand, the chemist ought not to take the stand that he knows it all."

A Kansas miller writes: "If the chemist will confine his reports to his actual findings and reserve his opinion until it is asked for, I do not believe that there will be much friction even if the chemist is working under the manager and not the superintendent."

The blame cannot altogether be attached to the chemists, according to a Texas miller, who says: "Millers are the most unreasonably suspicious men to be found anywhere. I don't know why, unless it's the strain on the nerves. This grows on a man with his age. I have to fight it constantly, myself. Changes in the mechanical end of the mill are usually worked out by the head miller weeks and months ahead of springing them on the manager. The miller naturally resents anyone capable of walking through the plant and analyzing its complications at a glance."

Another Texas miller reports: "Instances have come under my observation where the manager, or in some cases, the superintendent or head miller, had what I consider an unfortunate and unhappy faculty of creating and maintaining an atmosphere of jealousy and suspicion and ill-natured rivalry among all their subordinates. Such a man must have unusual talents in other directions if he can build and maintain a successful organization in such an atmosphere. I have known it done, but I believe such cases are rare. I know that the chemist and superintendent can get together and be mutually helpful, if they are both sensible men, by a frank and friendly approach and a freely expressed desire to get on common ground and co-operate in every way possible in all things pertaining to the advancement of the business from which they derive their support."

A New York miller tells us that friction will be avoided when millers come to their senses and realize that chemistry came into milling to help them, and not to do away with their positions.

Answering questions 9 and 10, whether a chemist should know more about milling and a miller know more about cereal chemistry, the majority of millers believe that the two are entirely distinct professions.

"Of course," as one superintendent puts it, "the chemist should know the difference between rolls and reels and the miller should know

the meaning of the different tests and how to apply them practically, but that is as far as either of them need to go."

This is a day of specialization, say most of the answers, and a man cannot be both a first-class chemist and a first-class miller.

With reference to this specialization idea, I received two letters which are so excellent as they stand that I hesitated to break them up. With your permission I'm going to read these in full. It won't take very long, and I'm sure their contents will interest you.

The first is written by an Eastern miller and the second by a Western miller.

(Letter from Eastern Miller)

Chemistry can usually show the reason why the product from certain wheats do not make good bread and also show why certain streams of flour in the mill do not produce a loaf of as good volume and color as others, and the baking test is said to be the final test. There is always, however, that eternal *if*, for in all the operations of milling and chemistry there are some points where an error is so easily possible that none are absolutely conclusive.

The routine work of the chemist of a mill should be that which will be of most service in its operation, and the chemist should make such determinations as the miller needs and asks for, and both should be workers together for God—good and good results will as certainly follow as day follows night.

Personally, I believe in specialization. I can put up a spout so that it *almost* fits. I can line up a shaft so that it is *almost* in line and *almost* even. I can bake a loaf of bread *almost* as good as that my wife bakes (though I admit it does not taste as good) and I can make an entry on the books in the office or I might be able to make up a bill for a customer that was *almost* correct, but if I want these things done right I should have a millwright, or a chemist or a bookkeeper and from these people I would expect work that was not *almost* correct but altogether as correct as humanly possible.

As to just how much of chemistry a miller should know or even how much of milling the chemist should know, depends entirely on the conditions surrounding.

If the miller is quite sure he has done all that he can do to bring his mill up to top notch in the milling line, using such advice as the chemist has been able to extend, and wishes to improve himself by the increased knowledge, well and good. It will help him to overcome his cowardice and sympathize with the other fellow's limitations. If the chemist has time left after making the determinations that have proven most helpful to the miller, a little study of milling may put him in better form for research work, which is very much needed.

(Letter from Western Miller)

It seems to me that the person who questions the utility of cereal chemistry in connection with the mechanics of the milling business, only reveals a provincial mind, or downright ignorance.

It is so firmly established in connection with some of the largest mills and flour brokers, bakers, etc., that it must be accepted as a valuable branch of knowledge.

So far as I can gather from the limited amount of reading I can do, the present problem with the cereal chemist is, his proper relations to the

operative miller or superintendent of the mechanics of the trade. I do not think any sane miller will question the value and utility of his services to the miller, manager or superintendent.

There seems to be some friction between the chemist and the superintendent or head miller, as to which shall take precedence. Where anything of this kind is found, the problem is very simple. Bring the matter to a show-down at once and let the miller, chemist and manager meet. Then let the miller say to the manager, and the manager is the one who must decide the matter; "I do not question the value of my friend, the chemist's, services to your business, but if his views are to take precedence over mine as to the mechanics of the mill, then let him *take the responsibility for the output.*" It seems to me that the matter could be settled so easily in this way.

Now, as a matter of fact, the chemist cannot be responsible for the mechanics of the mill unless he is also a trained miller with years of experience as such. The miller must be the responsible person, and direct personal responsibility there *must* be if the desired end is to be achieved. On the other hand, so much depends on the quality of the wheat as to final results that it is of the first importance that the miller know in advance just what the physical and chemical characters of the wheat really are, before he starts work with it. For this information he must look to the cereal chemist and he cannot very well do without this advance information.

I am heartily in accord with one of your correspondents who said that it is this advance information as to the quality of the wheat that is of the greatest value to the miller. It doesn't help the miller, when his work is done, to tell him that he fell down on it, except of course that it will be something of a guide in his future efforts. What he wants most is to have the pitfalls pointed out to him before he falls into them, and this is where the chemist "really shines" to use a colloquial expression.

I would not minimize the value of close tests of the flour after it is made. This, taken in connection with tests of the wheat, will prove of high value to the miller in regulating his practice; but I would set the higher value on a thorough chemical examination of the wheat. With this information available, the miller will often be able to show that the failure to secure the desired result in the finished product was due to a lack of desirable qualities in the wheat, and this can be corrected by the proper mixture or blend of other wheat possessing the requisite characteristics to bring out the desired result in the product.

As I write these lines, I have just passed my 45th year in the milling business, and am still going strong, but all I have learned in all these years only convinces me of how little I really know. The higher I go, the wider becomes my horizon which reveals to me the vast extent of possible knowledge and my incapacity to absorb even a small fraction of the truth regarding the phenomena which lie before and about me in such profusion.

When I confine my investigations to that small sphere wherein I pursue my vocation, I am still amazed at my ignorance, for in even this small sphere, the same phenomena is revealed. The more I know the more there is to learn, as the great truth is revealed to me that knowledge is simply the power to learn more of the limitless truth regarding the phenomenal world in which we live.

We have learned much about the mechanics of milling, it is true, and when one looks back on "The Stone Age" of the milling business, he is

struck with the significant advances made in our milling practice; yet if we may trust the analogy drawn from a philosophical view of life in general terms, it is certain that we have not yet arrived. Change is the law of Nature and that being true, our milling processes will change.

I am induced to make this wide generalization from observing the wide latitude in which millers work to achieve the end in view. One cannot but be impressed by the wide difference in methods as between the two-two methods of milling and the elaborate processes employed in our larger mills, with their endless reductions, and all the various systems in between these extremes.

Some of these must be better than others, as it is not possible that all are exactly alike, where so many diverse methods are employed; and if this is true, then some of them must be *wrong*. But just as we have arrived at this conclusion, someone suggests that the determining factor is not so much the utility of this or that method of the mechanics as it is a matter of adaptation to a certain environment.

Thus it is inadvisable to erect a 10 reduction mill in a rural community to serve a farmer clientele, and just as foolish to erect a 2-2 at a terminal market to serve an export trade. And even when we have properly settled this question of adaptation, we still have a wide latitude in our practice. Shall we make a very white, fine flour, or shall we sacrifice something in color to get a better granulation or coarser flour in the hope that it will prove stronger? Shall we do a little closer grinding on this break, or that smooth roll, or shall we use scratch or corrugated rolls on our middlings? And even when we have finally determined the proper postulate or theory on which we will base our practice, how shall we determine if it is the best, or even approximately correct? What tests shall we make, and who will make them? These are some of the questions which seem to me still questions only. No one seems to have reduced them to positively correct answers.

The foregoing wide generalizations may seem wide of the mark, but they seem necessary, either stated or consciously in view, to a solution of this question of the chemist in the mill, especially as to that last question, viz., "What tests are required, and who will make them," to determine if our practice is adequate to produce the desired results? It is certain that we cannot rely on the judgment of the average "housewife", for every miller will testify that when one has returned a sack of flour he has sent the same identical flour back to her, and she pronounced it fine, or sent it out to some other home, where it was accepted as the best ever. Of what earthly value is such testimony?

My own experience along this line has been so irritating that I have some to the conclusion that if I want to know—really KNOW anything about my flour, I must bake it myself and even then I cannot be sure of the results unless all of the conditions are uniform except the one under investigation.

There are so many factors which effect the fermenting and baking processes, that great care must be taken to have all the conditions uniform, and it seems to me that this requires that a number of them should be made at once to get accurate results. But—and here is where the chemist comes in—I haven't the time to do this work. It means, that if I am to get really reliable information on this subject, that I must know something

about my wheat in advance and after milling, I must test out the flour to learn if the results justify the theory on which I have worked in my milling on wheat of a known characteristic.

There is an abundance of this kind of work to be done to justify the work of a SPECIALIST and there you are. Hence the Chemist. We MUST have him, simply because no other person can give us the answer to our problems. We cannot rely on the housewife. The average woman doesn't know how to build a fire in a cook stove, let alone bake a batch of bread. Not one in a thousand is really trained in household duties, and have not the faintest idea of mechanics or chemistry, on even so small a scale as mixing a sponge. Even if one locates a good bread maker on whose work he relies, she is really an incipient chemist, is she not?

Suppose we declare for the baking test as the one and only reliable test as to the quality of our flour. Granted, but proceeding on the analogy derived from attempts to make bread from the flour of other grains, the possibility that some differences in the bread making quality of different varieties of wheat is suggested and we desire to be informed as to what the differences are, if any, and which possess the most desired qualities, and from this we go on, and before we know it we are up to our ears in cereal chemistry, and happy as pigs in clover.

How much reliance do I place in cereal chemistry? My answer is, that I recently sent two samples of flour to two chemists. One reported the flour NOT BLEACHED, the other reported it very much over-bleached. These two samples were taken from the same sample at the mill, and had an over-dose of chlorine, purposely administered to learn the effects of over-bleach with this gas. In this case, no adverse judgment could be drawn against cereal chemistry in general. It was certainly a case of incompetence in one individual.

One swallow doesn't make a summer, and one incompetent chemist doesn't make a case against the profession, any more than one or a dozen incompetent millers make a failure of milling in general. Cases could be multiplied without number, yet that would not prove the in-utility of the chemist. Primarily, the question is not as to the individual chemist. It's the value of the SERVICE we should consider. Once this is established, we shall have no difficulty in providing competent individuals to render it. I give it as my opinion that both the service and the personnel of those who purvey it are up to the average of other trades and professions.

I certainly do think millers should know more about cereal chemistry. The average small mill cannot afford to keep a chemist. What little work of that sort is done in the small mill must be done by the miller and this increase in his duties must be offset by some other of his duties being turned over to cheaper help which will require only his occasional supervision. Every mill, of any size or location, should have a small room in which the temperature and humidity can be kept at any desired point, and should be equipped with a small testing scale, testing sieves, running water, and facilities for baking. I do not know as this meager outfit could be dignified with the name of "Laboratory" or not, but for want of any better descriptive term, we will call it that. Other equipment could be added to fit the knowledge of the miller or his leisure or desire to go into the matter deeper. He could learn a lot like this.

I do not think the trade of the average small mill calls for very deep groping into the more refined niceties of the profession, but once a miller

starts with the scale and testing sieves, he will naturally progress in his investigations, and these will no doubt lead him on to closer investigations, and in time he will become as much of a chemist as any small mill has use for. There is not the need for this in the larger mills for they can afford to have a man specialie in that work, and he will have previous preparation, and time to do more elaborate work. I do not see where a knowledge of chemistry will help—say, a second miller in a large mill where a regular chemist is employed, nor is it clear to me that it will be of any use to the superintendent or head miller in a large mill that can afford the services of a chemist as a specialist. But as it is always possible that either of these may some time find himself in a small mill, either as proprietor or operative, he should be prepared to do some work along the lines of cereal chemistry if only in a very meager way.

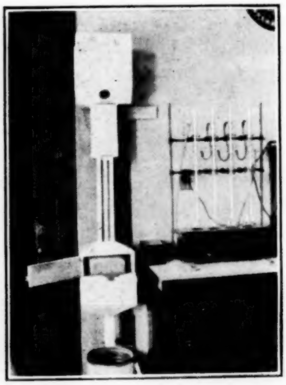
(Editor's Note.—Mr. Evans then told about the Milling Chemistry Department of National Miller; thanked Pres. Lawellin and other members of the A. A. C. C. who co-operated, and expressed a desire that the department be continued by the Association.)

A BREAD MEASURING DEVICE

By A. A. Heon

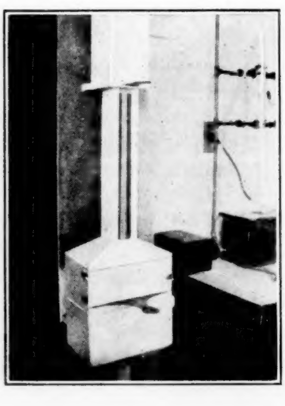
The writer had for a number of years, felt the want of an accurate and efficient. as well as time-saving appliance whereby the volume of bread could be ascertained in the laboratory.

With the above requisites in mind, the writer evolved the device shown in the photographs, which has, essentially, several connected containers or compartments with which the cubical contents of a loaf of bread is obtained, by the familiar method of seed displacement. Having used the several different bread measuring devices which have one or more factors of error in their manipulation, such as the settling of seed through jarring, loss of seed in transferring from one container to another, losing in part of the standard quantity of seed used for ascertaining the loaf volume, are a few of the more obvious inaccuracies occasioned in their use and which we believe have been eliminated in the apparatus shown in the photographs.



The device was designed to measure one pound loaves with a range of cubic centimeters or cubic inches in size. The block shown along the side of apparatus and measuring cc. was used for a minimum standard size.

The more important principal of the appliance is the fact that the small compartment underneath, the reservoir comprising the specific space between the two slides or valves, measures an identical standard quantity of seed for each loaf of bread, which fills the space around the loaf, and extends into the graduated class compartment, in direct ratio to the cubical contents of the measured loaf, which is indicated in cubic centimeters or inches on the scale. The larger slide underneath the loaf is then pulled out, allowing the seed to drop into a portable container beneath the appliance, which is again poured back into the reservoir after the measuring of about ten loaves in succession in about as many minutes, which is undoubtedly much quicker than any device now used will consume in a similar operation.



The above was constructed in our own work shop and we are aware that it could be improved upon in several ways, such as having a small elevator attached to a small motor, to elevate the seed back into the reservoir, etc. But as above stated, the feature is its accuracy, being stationary, and performing an important function in the cereal laboratory or a modern scientific bakery, where a check on the loaf volume is an important factor.

This apparatus has not been patented, and if it is an original invention, as the writer believes it to be, he is taking this opportunity of informing the cereal chemist, as well as the technical baker, that the writer will be glad to

have them make free use of his idea, with the hope that it will perhaps help just a little in arriving at accurate data, for the realization of that elusive object—a perfect loaf of Bread.

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